



Aeronautical
Engineering
A Continuing
Bibliography
with Indexes

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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

(Supplement 195)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in December 1985 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*



Scientific and Technical Information Branch 1986
National Aeronautics and Space Administration
Washington, DC

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INTRODUCTION

This issue of *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 389 reports, journal articles, and other documents originally announced in December 1985 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by the first nine *STAR* specific categories and the remaining *STAR* major categories. This arrangement offers the user the most advantageous breakdown for individual objectives. The citations include the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes -- subject, personal author, corporate source, foreign technology, contract number, report number, and accession number -- are included.

An annual cumulative index will be published.

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A Continuing Bibliography (Suppl. 195)

JANUARY 1986

01

AERONAUTICS (GENERAL)

A85-48567

THE COMPOSITE TECHNOLOGY OF A MAIN ROTOR BLADE

R A DOE and D HOLT (Westland Helicopters, Ltd, Yeovil, England) IN Fibre reinforced composites '84, Proceedings of the International Conference, Liverpool, England, April 3-5, 1984 London, Plastics and Rubber Institute, 1984, p 9 1-9 16

The composite materials system, structural design and fabrication methods of the Lynx/Westland 30 helicopter composite main rotor blade are discussed Attention is given to the accommodation of aerodynamic, blade weight, rotor balance, blade stiffness, and centrifugal force constraints, and to the manufacturing hardware employed in composite laminate tape-laying operations
O C

A85-48570

ASPECTS OF CERTIFICATION OF CIVIL AIRCRAFT STRUCTURES IN COMPOSITE MATERIALS

J W BRISTOW (Civil Aviation Authority, London, England) IN Fibre reinforced composites '84, Proceedings of the International Conference, Liverpool, England, April 3-5, 1984 London, Plastics and Rubber Institute, 1984, p 17 1-17 12 refs

The recent past has seen a marked increase in the application of composite materials to structures in civil aircraft - some examples are cited This paper discusses the issues raised in the airworthiness certification of such structures from the viewpoint of the Civil Aviation Authority An outline of the requirements that have to be met and the associated guidance material that has been recently evolved is given
Author

A85-48571

STRUCTURAL PLASTICS IN SPORTING AND GENERAL AVIATION AIRCRAFT

J FRAY (British Aerospace, PLC, Manchester, England) IN Fibre reinforced composites '84, Proceedings of the International Conference, Liverpool, England, April 3-5, 1984 London, Plastics and Rubber Institute, 1984, p 18 1-18 10

An historical account is given of the development of comparatively high performance primary structure design and fabrication techniques by sporting aircraft manufacturers, on the basis of the gradual improvement of glass-reinforced plastic materials Extensive use is noted to have been made of foamcore sandwich primary structures, which may ultimately lead to the rapid and simple assembly by amateur constructors of entire airframes composed of only a few large sandwich panels These technologies have recently been extended to executive aircraft
O C

A85-48573

THE FIRST BRITISH DESIGNED AND BUILT COMPOSITE SAILPLANE

J C RIDDELL (J C Riddell and Associates, England) IN Fibre reinforced composites '84, Proceedings of the International Conference, Liverpool, England, April 3-5, 1984 London, Plastics and Rubber Institute, 1984, p 20 1-20 10

Attention is given to evaluation methods recently applied to the composite materials used in the construction of a sailplane, proceeding from material properties and test structures to the proof loading of wing and tail panel prototype components and the ultimate strength structural testing of wing spars and fuselage The materials employed were fiberglass woven fabrics, balsa wood sandwich panel cores, and isophthalic polyester resins for laminate and gel coat applications
O C

A85-49089

ADVANCED TECHNOLOGIES PROMISE SALES BOOST FOR GENERAL AVIATION AIRCRAFT

J C LOWNDES Aviation Week and Space Technology (ISSN 0005-2175), vol 123, Sept 23, 1985, p 71, 73, 75 (5 ff)

The implementation of advanced aviation technologies, developed by NASA and aircraft manufacturers, in the design of new aircraft is discussed Wings and fuselages designed for natural laminar flow and the utilization of the strength and weight advantages of composite materials in aircraft design are described Canard and winglet aerodynamics are also being applied to new aircraft designs The improvements in measuring natural laminar flow and the advantages of the laminar flow airfoil are examined The use of graphite epoxy, filament winding, and low-temperature curing resin in fuselage designs is explained Some manufacturers have utilized flying scale models instead of wind tunnel tests to obtain basic stability and control data, the use of clay models is discussed Examples of aircraft which were developed from these technological advances are presented The development of a turbulent airfoil, an electromagnetic impulse deicing system, and a propfan installation is discussed
I F

A85-49127#

SUNRISE, THE WORLD'S FIRST SOLAR-POWERED AIRPLANE

R J BOUCHER (Astro Flight, Inc, Manna del Rey, CA) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p 840-846 Previously cited in issue 16, p 2277, Accession no A84-35214 refs

A85-49553

DETERMINING OPERATING AND SUPPORT COSTS WITH USAF DO56 MAINTENANCE DATA COLLECTION SYSTEM

R S MORRIS and B E BARTELS (Northrop Corp, Aircraft Div, Hawthorne, CA) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 197-206

Successful users of the USAF Maintenance Data Collection System - DO56 - have resolved and reduced the often deficient data, ascertaining maintenance action rates, reliability parameters and manpower resource consumption of weapon systems (or components thereof) Northrop Corporation utilizes the data to estimate support costs This paper will follow the development of the support cost for the F-5, from receipt of raw DO56 data, resolution of anomalies in the data, incorporation validated data

01 AERONAUTICS (GENERAL)

into a useable data base, and finally, the computation of operating and support costs using this data Author

A85-49571

MODELING COMBAT MAINTENANCE OPERATIONS

T N COOK and R C DINICOLA (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 390-395

A computer model was developed to simulate helicopter maintenance operations in combat. Written in GPSS computer code, the Combat Maintenance Simulator (CMS) mathematically models a fleet of helicopters performing combat missions. Scheduled inspections, system maintenance, and repair of battle damage are performed in the course of the simulation. The user is able to specify policies with regard to deferring nonessential maintenance and repair during periods of combat emergency. Computer graphics are used to display the mission performance of the fleet under various sets of conditions. The CMS models has been used to support research aimed at reducing the maintenance workload and increasing the mission capability of Army helicopters in combat Author

A85-49576

MODELING AIRCRAFT COMBAT DAMAGE REPAIR

D H KOVATCH (Vought Corp., Dallas, TX) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 440-445 refs

The development of an aircraft battle damage repair (ABDR) database, the REPAIR estimator model, and a damage simulator for estimating combat damage repair times of inflight and parked aircraft is discussed. The database, which is composed of a master file and a set of library files, is to define repair estimates as a function of a damage assessment and repair concept. The means of establishing standard and nonstandard repair estimates and the effect logistics and environmental conditions have on the estimate are explained. The REPAIR estimator model was developed to assist the processing of ABDR data and provide aircraft repair times, a flow chart of the model and an explanation of how the system functions are provided. The modified SCAN aerial target description and warhead endgame effectiveness program was used as the damage simulator model. The simulator, which predicts the probability of an aircraft surviving an attack by a missile, is described I F

A85-49584

SQUADRON MAINTENANCE AND REPAIR TECHNIQUES (SMART) VALIDATION TEST REPORT

H E ROSENBERG and B L BERSON (Lockheed-California Co., Burbank, CA) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 510-512

The purpose of this study was to evaluate the effectiveness of Lockheed's Squadron Maintenance and Repair Techniques (SMART) as a troubleshooting aid. Seven Naval enlisted personnel, ranging in experience levels of 0 to 5 years, served as the test subjects. The study was conducted on a P-3 Environmental Control System simulator board. The results of the study indicated that both inexperienced and experienced maintenance personnel could isolate faults quickly and efficiently using SMART. SMART has demonstrated the capability to reduce not only the time required to fault isolate equipment faults, but also the amount of training and skill level requirements for maintenance personnel Author

A85-49585

F/A-18 SUPPORTABILITY ASSURANCE READINESS PROGRAM

J J SINNOTT (McDonnell Aircraft Corp., St Louis, MO) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 513-519

The use of the Supportability Assurance Readiness Program (SARP) to evaluate the reliability, maintainability, and readiness of

the F/A-18 weapon/logistics support system is discussed. SARP compares the needs of the weapons system with readiness objectives and recommends adjustments if required, the elements necessary for system readiness are presented. The development of a data base which contains the reliability and maintainability performance of each item in the F/A-18 weapon system and the support elements required is described. Three SARP simulation models which were modified to accept time-dependent variations of simulation variables are discussed. The areas of projected support problems produced from the simulation models are explained. The correction of all projected problems was necessary in order to achieve an efficient system. The F/A-18 was compared with the F-4J and A-7E, the F/A-18 proved to be a better prepared aircraft requiring less maintenance, which results in reduced operating and support costs I F

A85-49657

ONE-ELEVEN TRAILBLAZERS

J MOXON Flight International (ISSN 0015-3710), vol 128, Sept 7, 1985, p 32-36

Over the last ten years, two aircraft have been employed in England to test new ideas in avionics, navigation, and flight control. The operations conducted with the aid of the two aircraft have made it possible to a mass a vast data base of knowledge. Direct voice input has been studied, and techniques for extremely accurate terminal area navigation have been established. Other studies conducted are related to relaxed stability and sophisticated gust alleviation. The conducted projects have the objective to help the UK avionics industry to gain a better foothold in world markets. Attention is given to the improvement of communications between the pilot and the outside environment, flight controls research, the simulation of terminal area holding patterns, automatic terminal area navigation, a new processing system, and a spoiler solution G R

A85-49927

WEIGHT CONTROL OF COMPOSITE PARTS IN PRODUCTION

R GILLIAM and J MACLENNAN (United Technologies Corp., Sikorsky Aircraft, Stratford, CT) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 13 p (SAWE PAPER 1629)

Use of composite materials in a production environment requires methods of weight control that are unique to composite structures. Stringent controls and continued monitoring of the materials, design practices, tooling, fabrication, and repair are required. Without these controls, the weight savings associated with the use of composites can very quickly be eroded. This paper addresses the specific weight control procedures employed at Sikorsky during each phase of the development process. It gives examples of weight savings degradation that occur without these controls and the orders of magnitude of weight that can be saved in specific component areas Author

N85-35152* National Aeronautics and Space Administration, Washington, D C

AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 190

Aug 1985 140 p (NASA-SP-7037(190), NAS 1 21 7037(190)) Avail NTIS HC \$6 00 CSDL 01A

This bibliography lists 510 reports, articles and other documents introduced into the NASA scientific and technical information system in July 1985 Author

N85-35153# Federal Aviation Agency, Washington, D C Office of Management Systems

U.S. CIVIL AIRMEN STATISTICS FOR CALENDAR YEAR 1984 Annual Report

31 May 1985 44 p (AD-A156326) Avail NTIS HC A03/MF A01 CSDL 01B

The U S Civil Airmen Statistics is an annual study published to meet the demands of FAA, other government agencies, and industry for more detailed airmen statistics than those published

in other FAA reports. Statistics pertaining to airmen, both pilot and nonpilot, were obtained from the official airman certification records maintained at the FAA Aeronautical Center, Oklahoma City, Oklahoma. An active airman is one who holds both an airman certificate and a valid medical certificate. Airmen who must have a valid medical to exercise the privileges of their certificate are all airplane pilots, control tower operators, flight navigators, flight engineers, and flight instructors. The glider and lighter-than-air pilots are not required to have a medical examination but the numbers represent only those who had a valid medical certificate. Mechanics, parachute riggers, ground instructors, and dispatchers certificates represent all certificates on record at the aeronautical center.

GRA

02

AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces, and internal flow in ducts and turbomachinery

A85-47103

COMPUTED STATIC STALL OF A SUPERCRITICAL AIRFOIL

D M SCHUSTER and Y TASSA (Lockheed-Georgia Co., Marietta) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p. 198-202. refs

The unsteady, turbulent flowfield about a supercritical airfoil in static stall has been simulated by numerically solving the two-dimensional time dependent Navier-Stokes equations. The simulation was obtained by impulsively starting the airfoil from a zero velocity condition and then marching in time by a pre-determined time step. The Navier-Stokes equations are solved at each of these time intervals yielding a time history of the flowfield. Turbulence characteristics of the flow are obtained via an algebraic turbulence model. Results are displayed using a two-dimensional contour plotter, 'DISPLA' graphics software and a VAX 11/780 computer.

Author

A85-47129

A FLOW VISUALIZATION STUDY OF THE EFFECT OF WING-TIP JETS ON WAKE VORTEX DEVELOPMENT

J M WU and F T GILLIAM (Tennessee, University, Tullahoma) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p. 387-391. refs (Contract F33615-81-K-3034)

The use of discrete wing-tip jets to improve the wing performance and to modify the tip vortex roll up has been investigated. A complicated three-dimensional vortex interaction in the vicinity of the wing tip flow field becomes more clear through the flow visualization study in a water tunnel. The existence of many induced secondary vortices was discovered. This finding leads to a theoretical model for analyzing the interacting vortices flow field. Flow visualization also helped in pointing out the direction for future study.

Author

A85-47132

THE USE OF FLOW VISUALIZATION FOR VORTEX TRAJECTORY MAPPING

R C NELSON (Notre Dame, University, IN) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p. 413-417. Research supported by the University of Notre Dame (Contract F08635-80-K-0303)

A flow visualization technique employed to study the vortical wake flows on slender bodies of revolution and delta wing configurations is presented. The technique was used to investigate

the leeward wake structure of bodies of revolution at large angles of attack. Both symmetric and asymmetric body vortex wakes were studied. The technique was also employed to study the leading edge vortex structure on delta wing models.

Author

A85-47134

QUANTIFICATION OF DOWNWASH AND GROUND VORTEX OF A LIFTING ROTOR MODEL BY FLOW VISUALIZATION TECHNIQUE

K WADA and H HAYAFUJI (Meijo University, Nagoya, Japan) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p. 428-433.

The ground effect of a lifting rotor model of 0.08-m diameter with a constant thrust coefficient of 0.01134, a blade pitch angle of 9 deg, and no cyclic pitch control was studied in the open test section of a low-speed wind tunnel. The rotor downwash velocity and the ground vortex were visualized by using a smoke wire, a sheet of aluminum-tuft grid, and a wing wheel. An analysis of flow photographs made it possible to quantify the downwash and the ground vortex. Test results are presented in graphical form.

V L

A85-47144

VISUALIZATION STUDIES OF JET IMPINGEMENT FLOWS AT MCDONNELL DOUGLAS RESEARCH LABORATORIES

K R SARIPALLI (McDonnell Douglas Research Laboratories, St Louis, MO) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p. 503-509. Research supported by the McDonnell Douglas Independent Research and Development Program. refs

Visualization experiments were conducted in water to study jet impingement flows simulating the hover flight mode of vertical take-off and landing aircraft. The principal flow visualization technique used a fluorescent dye (fluorescein-sodium) as tracer fluid, with illumination by a sheet of light obtained by spreading a laser beam. Streak-line flow patterns were also obtained using air bubbles as tracer particles. The impingement configurations of a single jet issuing from a circular blocking plate, fountain-forming twin jets without a blocking plate, and inclined twin and quadruple jets were studied. The flow patterns in different cross sections of the flow were photographed for varying configuration parameters and jet velocities.

Author

A85-47149

VISUALIZATION OF THE VORTEX FLOW OVER DELTA AND DOUBLE-DELTA WINGS

N G VERHAAGEN (Delft, Technische Hogeschool, Netherlands) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p. 652-657.

The structure of the vortex flow above and behind a sharp-edged delta wing and two sharp-edged double-delta wings has been investigated by employing a laserlight-sheet visualization technique. The investigation has been carried out at a free-stream velocity of 30 m/sec, corresponding to a Reynolds number of 1.4 million, based on centerline chord length.

Author

A85-47163#

ON THE ACCURACY OF BOUNDARY LAYER MEASUREMENTS IN CASCADES AT HIGH SUBSONIC SPEEDS

M HOEGER and H HOEISEL (DFVLR, Institut fuer Entwurfsaerodynamik, Brunswick, West Germany) IN Measuring techniques for transonic and supersonic flow in cascades and turbomachines, Proceedings of the Seventh Symposium, Aachen, West Germany, September 21-23, 1983. Aachen, Institut fuer Strahlantriebe und Turboarbeitsmaschinen, 1984, p. 6-1 to 6-22. refs

The accuracy of boundary layer measurements performed with flattened pitot tubes at high subsonic speeds was analyzed. The effect of Mach and Reynolds number, wall interference, probe position, and static pressure variation on the boundary layer results is investigated. Accuracy is estimated for the velocity profiles on

02 AERODYNAMICS

the suction surface of a compressor cascade and a turbine cascade. A comparison of laser Doppler anemometry and probe measurements within the boundary layer of a single airfoil showed satisfactory agreement B J

A85-47164#

COMPARISON OF A COMPUTED TRANSONIC FLOW AND INTERFEROMETRIC MEASUREMENTS AROUND THE LEADING EDGE OF A TWO DIMENSIONAL AEROFOIL ASYMMETRICALLY MOUNTED IN A WIND TUNNEL

P J BRYANSTON-CROSS and J D DENTON (Cambridge University, England) IN Measuring techniques for transonic and supersonic flow in cascades and turbomachines, Proceedings of the Seventh Symposium, Aachen, West Germany, September 21-23, 1983 Aachen, Institut fuer Strahlantriebe und Turbomaschinen, 1984, p 7-1 to 7-15 SERC-supported research refs

A two-dimensional numerical solution using an inviscid time marching method for the design of the leading edge profile of a transonic airfoil is compared with interferometric data obtained from image plane holograms. The comparison has been made for the whole blade profile including the trailing edge shock region. A particularly detailed analysis was made in the leading edge region where the flow is accelerated from stagnation conditions to $M = 1.25$ in 2 mm. The agreement between the calculated and measured flow around the airfoil section was found to be very good, and the time marching scheme adopted was found to predict with high resolution the flow around the leading edge of the blade despite a partial flow blockage B J

A85-47262

SOME RESULTS OF EXPERIMENTAL AND ANALYTICAL BUFFETING INVESTIGATIONS ON A DELTA WING

J BECKER (Messerschmitt-Boelkow-Blohm GmbH, Hubschrauber und Flugzeuge, Munich, West Germany) and A GRAVELLE (ONERA, Chatillon-sous-Bagneux, France) (International Symposium on Aeroelasticity and Structural Dynamics, 2nd, Aachen, West Germany, Apr 1-3, 1985) ONERA, TP, no 1985-59, 1985, 36 p (ONERA, TP NO 1985-59)

Results of an investigation on the buffeting characteristics of a delta wing configuration are presented. The dynamic response on the wing of a tactical fighter type aircraft at high speed and incidence is calculated by using a semiempirical method. Separation induced unsteady pressure distributions measured on a wind tunnel model are evaluated to formulate aerodynamic excitation forces. Motion induced unsteady pressure distributions caused by harmonic roll oscillations of the model are used for a correction of aerodynamic system forces. The separation-induced buffet forces and the corrected theoretical motion-induced aerodynamic forces are established for various conditions of steady model incidence, reduced frequency, Mach number and Reynolds number. The semiempirical method is tested first by recalculation of the measured model response, and is applied to predict the buffeting of total rigid aircraft and its elastic wing. The wind tunnel measurements of this investigation were performed in a joint MBB/ONERA program in the ONERA tunnel 52 MA at Modane Author

A85-47269#

EXTENSION AND USE OF NUMERICAL PROCEDURE FOR THE THREE DIMENSIONAL UNSTEADY TRANSONIC FLOWS

P MULAK, J L MEURZEC, and J J ANGELINI (ONERA, Chatillon-sous-Bagneux, France) (International Symposium on Aeroelasticity and Structural Dynamics, 2nd, Rheinisch-Westfaelische Technische Hochschule, Aachen, West Germany, Apr 1-3, 1985) ONERA, TP, no 1985-67, 1985, 10 p refs (ONERA, TP NO 1985-67)

Recently a numerical procedure has been developed at ONERA to solve the unsteady transonic flow problems under 'potential flow' and 'small perturbation approximations', in the case of the most general planform wings. The use of an Alternating Direction

Implicit procedure (ADI) and a functional approach has allowed a correct approximation for the small perturbation equation with consistent boundary conditions, obtained within a very reasonable computing time. Flexible models can now be taken into consideration and flutter calculations executed. The purpose of this paper is to present such results on a supercritical wing. Comparisons with experiments and the classical linear method (doublet lattice) are made Author

A85-47301#

AERODYNAMIC MODELS FOR PROPELLERS FOR FAST AIRCRAFT [CALCULS AERODYNAMIQUES D'HELICES POUR AVIONS RAPIDES]

J M BOUSQUET (ONERA, Chatillon-sous-Bagneux, France) (Groupe Sectoriel Franco-Sovietique - Aeronautique, Sous-groupe Aerodynamique, Acoustique Aeronautique et Structures, Reunion, 27th, Chatillon-sous-Bagneux, France, Mar 11-15, 1985) ONERA, TP, no 1985-55, 1985, 24 p In French DRET-supported research refs (ONERA, TP NO 1985-55)

Features of several models being developed to describe the aerodynamics of propellers for transonic aircraft are outlined and compared with preliminary experimental results. The interest in propfans was spurred by NASA studies which have demonstrated potential efficiency gains at performance levels comparable to turbojet-powered transport aircraft. Traditional lifting line theory models provide a basis for curved lifting line, incompressible lifting surface and three-dimensional models for the propfan configurations, which are of smaller diameter than classic propeller systems and therefore must rotate at higher speeds. The validity of the new models has been established in tests of a 1 m diameter propfan in the Modane S1 wind tunnel. It is concluded that the models are of use in defining efficient airfoil shapes for realizing the potential of propfans and also as an aid in noise reduction studies M S K

A85-48189

CONTRIBUTION TO THEORY OF SIMILITUDE OF SUBSONIC FLOW

A A SHAGAEV (TsAGI, Uchenye Zapiski, vol 15, no 2, 1984, p 1-10) Fluid Mechanics - Soviet Research (ISSN 0096-0764), vol 13, Jan-Feb 1984 (1985), p 19-30 Translation refs

The accuracy of the rules of similitude of subsonic flows about wings with infinite and finite span is analyzed. An asymptotic estimate is presented for errors of various rules correcting for compressibility and it is shown that the error of such rules can be minimized by optimum selection of the subsonic similitude parameter and by using the exact formulation of the incompressible potential flow about affine-similar foils. A similitude rule for pressure diagrams of affine-similar foils, valid in the second approximation of the subsonic theory of slender foils, is formulated. The results of calculations using approximate rules for correction for compressibility and numerical solutions of the exact equation of the potential in the case of two- and three-dimensional flows are compared Author

A85-48520*# Analytical Services and Materials, Inc., Tabb, Va A STUDY OF LAMINAR SEPARATION BUBBLE IN THE CONCAVE REGION OF AN AIRFOIL USING LASER VELOCIMETRY

S M MANGALAM (Analytical Services and Materials, Inc., Tabb, VA), J F MEYERS, J R DAGENHART, and W D HARVEY (NASA, Langley Research Center, Hampton, VA) ASME, Laser Velocimetry Symposium, Miami, FL, Nov 17-21, 1985, Paper 9 p. refs

Laser velocimetry (LV) was used to study the nature of laminar separation bubbles in the concave region of a 1.83-meter airfoil model which was tested in the NASA Langley Low Turbulence Pressure Tunnel. Three component, coincident data from LV measurements including histograms of particle velocity, mean velocity profiles, turbulence intensity, and Reynolds stresses within the shear layer were used to determine the locations of laminar separation, transition, and turbulent reattachment boundary-layer

parameters determined from velocity profiles were used to compare the results with existing empirical relations for describing the laminar separation bubble
Author

A85-48526*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif

**A COMPUTATIONAL STUDY OF COMPLEX
THREE-DIMENSIONAL COMPRESSIBLE TURBULENT
FLOWFIELDS**

C C HORSTMAN (NASA, Ames Research Center, Moffett Field, CA) AIAA Journal (ISSN 0001-1452), vol 23, Oct 1985, p 1461, 1462 Abridged Previously cited in issue 17, p 2424, Accession no A84-37970

A85-48529#
**THEORETICAL AND EXPERIMENTAL STUDY OF
NONADIABATIC TRANSONIC SHOCK/BOUNDARY-LAYER
INTERACTION**

G R INGER (Iowa State University of Science and Technology, Ames), F T LYNCH, and M. F FANCHER (Douglas Aircraft Co., Long Beach, CA) AIAA Journal (ISSN 0001-1452), vol. 23, Oct 1985, p 1476-1482 Previously cited in issue 15, p 2120, Accession no A83-34901 refs

A85-48530#
**A THREE-DIMENSIONAL, BLOCK-STRUCTURED FINITE
ELEMENT GRID GENERATION SCHEME**

A ECER, J SPYROPOULOS, and J D MAUL (Purdue University, Indianapolis, IN) AIAA Journal (ISSN 0001-1452), vol 23, Oct 1985, p 1483-1490 Previously cited in issue 06, p 701, Accession no A84-17827 refs
(Contract AF-AFOSR-80-0258)

A85-48531*# Purdue Univ., Lafayette, Ind
**FLOW INSTABILITIES IN TRANSONIC SMALL-DISTURBANCE
THEORY**

M H WILLIAMS (Purdue University, West Lafayette, IN), S R BLAND, and J W EDWARDS (NASA, Langley Research Center, Hampton, VA) AIAA Journal (ISSN 0001-1452), vol 23, Oct 1985, p 1491-1496 Previously announced in STAR as N85-18000 refs

The dynamics of unsteady transonic small disturbance flows about two-dimensional airfoils is examined, with emphasis on the behavior in the region where the steady state flow is nonunique. It is shown that nonuniqueness results from an extremely long time scale instability which occurs in a finite Mach number and angle of attack range. The similarity scaling rules for the instability are presented and the possibility of similar behavior in the Euler equations is discussed
Author

A85-48532#
**CALCULATION OF THREE-DIMENSIONAL FLOWFIELDS BY
THE UNSTEADY METHOD OF CHARACTERISTICS**

D L MARCUM and J D HOFFMAN (Purdue University, West Lafayette, IN) AIAA Journal (ISSN 0001-1452), vol 23, Oct 1985, p 1497-1505 Previously cited in issue 06, p 711, Accession no A84-18095 refs

A85-48533*# Washington Univ., Seattle
**MULTIPLE TRANSONIC SHOCK-WAVE/TURBULENT
BOUNDARY-LAYER INTERACTION IN A CIRCULAR DUCT**

D OM and M E CHILDS (Washington University, Seattle) AIAA Journal (ISSN 0001-1452), vol 23, Oct 1985, p 1506-1511 Previously cited in issue 17, p. 2446, Accession no. A83-37220 refs
(Contract NGR-48-002-047, NGR-48-002-141)

A85-48534#
**THE SUBSONIC NEAR-WAKE OF AN AXISYMMETRIC
SEMIELLIPTICAL AFTERBODY**

R A MERZ (Lafayette College, Easton, PA), C H YI (Union Carbide Corp., Polyolefins Div., Bound Brook, NJ), and C E G PRZIREMBEL (Clemson University, SC) AIAA Journal (ISSN 0001-1452), vol 23, Oct. 1985, p 1512-1517 refs

The near-wake of axisymmetric semielliptical afterbody was studied experimentally in a wind tunnel at 47 m/s using an upstream support system to minimize disturbances to the wake. The flowfield was surveyed with a variety of pressure and hot-wire probes. This paper presents the mean flowfield characteristics for the entire near-wake region. The results include static and stagnation pressure distributions as well as velocity profiles. Separation occurred at 0.38 model radii upstream of the base, while realignment was found at 0.2 model radii downstream. Centerline velocity recovery is slower than for blunt bases, but far-wake similarity was found as early as 0.4 radii downstream. The overall flowfield is heavily influenced by the wall geometry. The data presented will serve as a quantitative basis for the development and evaluation of analytical solutions
Author

A85-48539*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
**INVISCID AND VISCOUS FLOWS IN CASCADES WITH AN
EXPLICIT MULTIPLE-GRID ALGORITHM**

R V CHIMA (NASA, Lewis Research Center, Cleveland, OH) AIAA Journal (ISSN 0001-1452), vol 23, Oct 1985, p 1556-1563 Previously cited in issue 17, p 2427, Accession no A84-38043 refs

A85-48874#
**SUPPLEMENTS TO 'THEORY OF SECONDARY FLOW IN
CASCADES'**

S OTSUKA (Nagoya University, Japan) Nagoya University, Faculty of Engineering, Memoirs (ISSN 0027-7657), vol 36, Nov 1984, p 118-137 refs

The secondary flow in a two-dimensional cascade has been investigated experimentally in a high-speed cascade wind tunnel. It is shown that the direction of the wake has a definite value which is independent of the aspect ratio of the cascade when loss coefficients are low. The direction of the secondary flow was related to the direction of the mean exit flow measured by a yaw meter. The experimental results confirmed the theoretical flow calculations of Otsuka (1977)
IH

A85-48875#
**NUMERICAL ANALYSIS OF TRANSONIC FLOW AROUND A
TWO-DIMENSIONAL AIRFOIL BY SOLVING FULL
NAVIER-STOKES EQUATIONS**

Y-Y WANG and T FUJIWARA (Nagoya University, Japan) Nagoya University, Faculty of Engineering, Memoirs (ISSN 0027-7657), vol 36, Nov 1984, p 138-178 refs

An effective finite-difference scheme for solving full compressible Navier-Stokes equations was initiated by Beam and Warming. The purpose of this paper is to develop that technique and apply it to the calculations of several typical subsonic and transonic, inviscid and viscous steady flows for NACA 0012 airfoil. Part of the analysis briefly contains the derivation process of all used formulas and the empirical treatments. Inviscid and viscous flows are analyzed separately, along with associated grid formation techniques and boundary conditions
Author

02 AERODYNAMICS

A85-48988

EXPERIMENTAL METHOD FOR THE STUDY OF CORNER FLOWS [METHODE EXPERIMENTALE D'ETUDE DES ECOULEMENTS DE COIN]

J COUSTEIX and G PAILHAS (ONERA, Centre d'Etudes et de Recherches de Toulouse, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 21st, Ecully, France, Nov 7-9, 1984 39 p In French (AAAF PAPER NT 84-06)

A four-wire hot-wire anemometer was devised for obtaining data on the three velocity components in corner flows such as are present at wing-fuselage joints and between rows of turbomachinery blades. The sensor is calibrated to extract the angular sensitivity of velocity values obtained. Data from the probe are analyzed statistically to extract the average velocities and the Re stresses. Details of the numerical model for interpreting the data are discussed. Sample pressure and velocity data are provided for flow passing a wing-fuselage junction. The data expose the formation of an initial nonuniform boundary layer containing cells of longitudinal vortices. M S K

A85-48989

THE UNSTEADY PROPERTIES OF A FLOW WITHIN A SCHEMATIC AIR INTAKE [PROPRIETES INSTATIONNAIRES DE L'ECOULEMENT A L'INTERIEUR D'UNE PRISE D'AIR SCHEMATIQUE]

P GRAYSON and J P FLODROPS (Lille I, Universite, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 21st, Ecully, France, Nov 7-9, 1984 43 p In French DRET-supported research (AAAF PAPER NT 84-09)

Experimental results are presented from wind tunnel studies of the two-dimensional vortical structures that form beyond the lip of a variable height air duct. The recirculating, divergent tunnel used had a 40 x 200 mm test channel. Two parallel, 8 mm thick flat plates, whose separation distance was controllable, were used in the studies. The effects of 20, 30, 40, and 60 mm separations were examined in flows with velocities between Mach 0.4-0.5. Interior data were obtained using pressure probes along and off the wall. Strio-interferometry was employed to generate flow visualizations. The appearance of the vortical fluctuations was found to be due to the interior pressure fluctuations. M S K

A85-48990

TURBULENCE IN AIR INLETS [LA TURBULENCE DANS LES MANCHES A AIR]

J C COURT, C CAMBON, and M HAMADICHE (Avions Marcel Dassault-Breguet Aviation, Vaucresson, Lyon, Ecole Centrale, Ecully, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 21st, Ecully, France, Nov 7-9, 1984 42 p In French refs (Contract DRET-77-410, DRET-80-552) (AAAF PAPER NT 84-10)

A spectral approach is taken to model turbulent shear flows within air intakes at high angles of attack. The model was developed to understand the effects of longitudinal and transversal pressure gradients on the turbulence. Using wind tunnel velocity fluctuation data for the interior of a compressor as a basis, a spectral model of anisotropic homogeneous turbulence is defined, including initial and boundary conditions. It is found, after examining the experimental data, that the fluctuations will probably appear at angles of attack over 14.5 deg. The fading of the largest fluctuations will be equivalent to the global fading of the fluctuations. It is therefore recommended that subsequent studies be focused on identifying the highest magnitude fluctuations. M S K

A85-48991

A FINITE DIFFERENCE MODEL FOR FLOWS AROUND AN AIR INTAKE [CALCUL DE L'ECOULEMENT AUTOUR D'UNE PRISE D'AIR EN DIFFERENCES FINIES]

J P FAIDY (Avions Marcel Dassault-Breguet Aviation, Vaucresson, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 21st, Ecully, France, Nov 7-9, 1984 45 p In French refs (AAAF PAPER NT 84-11)

A finite difference model is presented for simplifying the calculations necessary for designing air intake ducts for high performance military aircraft. The potential equation for a perfect fluid is written in nonconservative form in cylindrical coordinates. Account is taken of the presence of a conical object in the duct to assure flow stability in the presence of supersonic shocks. The three-dimensional geometry of the intake and cone is treated in terms of a series of longitudinal cross-sections in rotation from the center of the cone. Sample calculations for supersonic flow phenomena in the intake, when compared with wind tunnel data, show satisfactory agreement even though entropy and viscous effects are neglected. M S K

A85-48993

THE CHARACTERISTICS OF UNSTEADY FLOW IN AIR INTAKES [CARACTERISTIQUES DE L'ECOULEMENT INSTATIONNAIRE DANS LES ENTREES D'AIR]

M BOURIOT, J DELVILLE, and H GAREM (Poitiers, Universite, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 21st, Ecully, France, Nov 7-9, 1984 22 p In French refs (Contract DRET-83-146) (AAAF PAPER NT 84-13)

Past and current experimentation to characterize flows in jet engine intakes at the French Center for Aerodynamic and Thermal Studies are reviewed. Experiments on circular and planar intakes have thus far covered the characteristic scales of flow phenomena, wall effects and visualizations, probabilistic velocity and pressure conditions and coherence lengths. Presently, attempts are being made to extend all the previous techniques and measurements, which were in the two-dimensional regime, to three dimensions. The trials are performed in a square-section jet-powered wind tunnel. Instrumentation is available for 18 separate flow measurements spaced 10 deg apart and at five radial locations in the intakes tested. Calibration methods are detailed and initial results for flow velocities in intakes are compared with equivalent data from other wind tunnels. M S K

A85-48998

CALCULATION OF THE FLOW IN AN AIR INTAKE DUCT BY NUMERICAL SOLUTION OF THE EULER EQUATIONS [CALCUL DE L'ECOULEMENT DANS UNE ENTREE D'AIR PAR RESOLUTION NUMERIQUE DES EQUATIONS D'EULER]

CH KOECK (Matra, S A, Velizy-Villacoublay, France) Association Aeronautique et Astronautique de France, Colloque d'Aerodynamique Appliquee, 21st, Ecully, France, Nov 7-9, 1984 25 p In French refs (AAAF PAPER NT 84-24)

Techniques are presented for solving the Euler equations applied to modeling the flow in an intake duct such as found on a turbojet-powered missile. Boundary conditions are defined in terms of wall friction, supersonic upstream flow variables, static pressure downstream, and subsonic velocity and drag forces. A finite volume approach is taken, using multiple grids, to obtain a two-dimensional solution. Account is taken of sideslip and the effects of different angles of attack. The method permits predictions of flow distortions which would cause asymmetrical intake flows. It is noted that a viscous treatment will not necessarily ensure the desired intake conditions. M S K

A85-49014* Ohio State Univ., Columbus

MODELING TECHNIQUES FOR TRANSONIC AIRFOILS

S. L. PETRIE, R. J. FREULER, G. M. GREGOREK, and M. B. BRAGG (Ohio State University, Columbus) IN Aerospace simulation; Proceedings of the Conference, San Diego, CA, February 2-4, 1984 La Jolla, CA, Society for Computer Simulation, 1984, p 125-143. refs
(Contract NAS1-14406)

In the present comparative study of computer codes for the modeling of two-dimensional, single element airfoil sections for various section geometry classes, two of the codes use vortex singularity methods to obtain the potential flow solution while the remainder solve the full inviscid potential flow equations by means of finite differencing techniques that allow results to be obtained for transonic flow about an airfoil which includes weak shocks. Computational results are presented for a symmetrical airfoil section, a conventional section, and a supercritical one. Icing condition applications of the models are noted The model codes' range of applicability and agreement with each other and experimental results, as well as their computer run times and memory requirements, are noted O C

A85-49126#

VERIFICATION OF CALCULATION METHODS FOR UNSTEADY AIRLOADS IN THE PREDICTION OF TRANSONIC FLUTTER

R. J. ZWAAN (Nationaal Lucht- en Ruimtevaartlaboratorium, Amsterdam, Netherlands) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p 833-839 Research supported by the Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart en Rijksluchtvaartdienst refs
(AIAA PAPER 84-0871)

Various engineering-type methods to calculate unsteady airloads on wings in transonic flow were applied in flutter calculations for a semispan flutter model of a supercritical wing Verification was performed on the basis of comparing flutter characteristics, in which special attention was given to the prediction of transonic dips in the flutter boundaries. The methods were able to produce useful results when applied complementarily Author

A85-49129#

GRID GENERATION AND FLOW CALCULATIONS FOR AIRCRAFT GEOMETRIES

N. P. WEATHERILL and C. R. FORSEY (Aircraft Research Association, Ltd., Bedford, England) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p 855-860 Research supported by the Ministry of Defence (Procurement Executive) Previously cited in issue 17, p 2427, Accession no A84-38044 refs

A85-49131*# Naval Ship Research and Development Center, Bethesda, Md

NUMERICAL OPTIMIZATION OF CIRCULATION CONTROL AIRFOIL AT HIGH SUBSONIC SPEED

T. C. TAI (David W. Taylor Naval Ship Research and Development Center, Bethesda, MD) and G. H. KIDWELL, JR (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct. 1985, p 869-874 Navy-supported research Previously cited in issue 21, p 2988, Accession no A84-44198 refs

A85-49133*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

FULL POTENTIAL SOLUTIONS OF THREE-DIMENSIONAL SUPERSONIC FLOWS

K. M. JONES, N. A. TALCOTT, JR (NASA, Langley Research Center, Hampton, VA), and V. SHANKAR (Rockwell International Science Center, Thousand Oaks, CA) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p 881-887. Previously cited in issue 06, p. 705, Accession no A84-17907 refs

A85-49138#

IS ANY FREE FLIGHT/WIND TUNNEL EQUIVALENCE CONCEPT VALID FOR UNSTEADY VISCOUS FLOW?

L. E. ERICSSON (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p 915-919 Previously cited in issue 07, p 845, Accession no A85-19708 refs

A85-49141*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

A WIND TUNNEL INLET FLOW SIMULATION

U. K. KAUL (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p. 927, 928 Previously cited in issue 07, p 850, Accession no A85-20869 refs

A85-49149

FINITE ELEMENT SIMULATION OF TRANSONIC FLOWS BY MODIFIED POTENTIAL AND STREAM FUNCTION METHODS

W. G. HABASHI (Concordia University, Montreal, Pratt and Whitney Canada, Longueuil, Canada), P. L. KOTIUGA, and L. A. MCLEAN (Pratt and Whitney Canada, Longueuil, Canada) Engineering Analysis (ISSN 0264-682X), vol 2, Sept 1985, p 150-154 refs

This paper presents three alternatives to the classical velocity potential formulation, for inviscid flows with strong shocks The first method is based on a modified potential, the second on a transonic stream function formulation and the third on a combination that approximates the Euler set of equations These methods are used to successfully model external flows with strong shocks and choked internal and turbomachinery flows Author

A85-49353* Massachusetts Inst of Tech, Cambridge

UNSTEADY LIFTING-LINE THEORY AS A SINGULAR-PERTURBATION PROBLEM

A. AHMADI and S. E. WIDNALL (MIT, Cambridge, MA) Journal of Fluid Mechanics (ISSN 0022-1120), vol 153, April 1985, p 59-81 refs
(Contract NGR-22-009-818)

Unsteady lifting-line theory is developed for a wing of large aspect ratio oscillating at low frequency in inviscid incompressible flow The wing is assumed to have a rigid chord but a flexible span Use of the method of matched asymptotic expansions reduces the problem from a singular integral equation to quadrature The pressure field and airloads, for a prescribed wing shape and motion, are obtained in closed form as expansions in inverse aspect ratio A rigorous definition of unsteady induced downwash is also obtained Numerical calculations are presented for an elliptic wing in pitch and heave, compared with numerical lifting-surface theory, computation time is reduced significantly The present work also identifies and resolves errors in the unsteady lifting line theory of James (1975), and points out a limitation in that of Van Holten (1975, 1976, 1977) Author

A85-49356

COMPUTATION OF INVISCID INCOMPRESSIBLE FLOW WITH ROTATION

A. RIZZI and L.-E. ERIKSSON (Flygtekniska Forsöksanstalten, Bromma, Sweden) Journal of Fluid Mechanics (ISSN 0022-1120), vol 153, April 1985, p 275-312 refs

In numerical studies of incompressible flow fields possessing substantial regions with rotation, difficulties can arise due to the task of having to set up vortex-sheet discontinuities in the field The alternative is to adopt the Euler equations as the flow model The recent discovery that a vortex sheet can be generated in the solution of a compressible flow field with separation from the leading edge of a delta wing at high angle of attack has led to the development of numerical methods to solve the compressible Euler equations However, difficulties arise with respect to the employment of these methods in the case of an incompressible problem. The present investigation has the objective to describe a rather general numerical method which takes the artificial-compressibility approach for solving the steady incompressible Euler equations G R

A85-49366

CHARACTERISTICS OF A TRAILING-EDGE FLOW WITH TURBULENT BOUNDARY-LAYER SEPARATION

B E THOMPSON and J H WHITELAW (Imperial College of Science and Technology, London, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol 157, Aug 1985, p 305-326 SERC-supported research refs

Experimental techniques, including flying-hot-wire anemometry, have been used to determine the pressure and velocity characteristics of a flow designed to simulate the trailing-edge region of an airfoil at high angle of attack. Emphasis is placed on the region of recirculating flow and on the downstream wake. It is shown that the effect of this recirculation is large even though the details of the flow within it may be unimportant. Normal stresses and cross-stream pressure gradients are important immediately upstream and downstream of the recirculating flow and are associated with strong streamline curvature. The relative importance of the terms in the transport equations for mean momentum and turbulence energy are quantified and the implications for procedures which solve potential-flow and boundary-layer equations and for alternative calculation methods are discussed.

Author

A85-49369

A NOTE ON THE STEADY HIGH-REYNOLDS-NUMBER FLOW ABOUT A CIRCULAR CYLINDER

D H PEREGRINE (Bristol, University, England) Journal of Fluid Mechanics (ISSN 0022-1120), vol 157, Aug 1985, p 493-500 refs

The most detailed theoretical description of the steady flow at high Reynolds number about a circular cylinder is given by Smith (1979). It appears to give a satisfactory description of much of the flow field. Numerical solutions for this flow computed by Fornberg (1985) are in conflict with some aspects of Smith's model. An acknowledged weak point in Smith's argument is the lack of a detailed flow for the interior of the eddies, particularly with respect to their rear closure. This paper discusses this aspect of the flow with particular emphasis on the vorticity distribution and with the aid of a solution of the Navier-Stokes equations which is valid at the rear of the eddies. As a result an interpretation of Fornberg's (1980, 1985) results is possible. The self-induced velocity of translation of the vorticity distribution is considered and discussed with reference to the flow as Re approaches infinity.

Author

A85-49652#

APPROXIMATE CALCULATION OF FLOW FIELD IN AN INLET WITH ARBITRARY CROSS SECTIONS AND CURVED AXIS

C LIN (Northwestern Polytechnical University, Xian, People's Republic of China) (Journal of Applied Mechanics, vol 1, no 1, 1984) Northwestern Polytechnical University, English Translation of Selected Papers, ET-12 to ET-17, July 1985, 13 p. Translation.

An approximate solution for steady compressible inviscid potential flow in a slender inlet with a curved axis and arbitrary cross section is obtained using the asymptotic expansions of the flow variables in the framework of the perturbation method. It is shown that the axial velocity component at the centroid of the cross section is equal to the one-dimensional value, while that at a point other than the centroid is inversely proportional to the distance between the point and the center of curvature of the axis. In addition, it is demonstrated that the cross-sectional velocity components can be divided into two parts, with one corresponding to the variation of the cross-section area and the other corresponding to the variation of the cross-section shape.

B J

A85-49698

ON THE ABRUPT TURBULENT REATTACHMENT DOWNSTREAM OF LEADING-EDGE LAMINAR SEPARATION

F T SMITH (University College, London, England) and J W ELLIOTT (Hull, University, England) Royal Society (London), Proceedings, Series A - Mathematical and Physical Sciences (ISSN 0080-4630), vol 401, no 1820, Sept 9, 1985, p 1-27 SERC-supported research refs

The unsteady marginal separations in a classical boundary layer are investigated theoretically. The problem of local flow is reduced to the solution of a nonlinear integropartial differential equation for the unknown scaled skin friction which is also proportional to the decrement in the displacement. Numerical solutions for the separations are evaluated analytically, and the results are discussed. It is shown that all short length small disturbances are unstable whenever reversed flow occurs, but for sufficiently confined initial conditions the instabilities accumulate which lead to breakdown after a finite time. In nonlinear breakdown a double structure arises near the point of collapse with an effective 'shock' taking the flow abruptly from the reversed sense just upstream to the forward sense just downstream. The shock forms the link to the sudden transition and turbulent reattachment of laminar eddies at the rounded leading edges. The turbulence effects and the related phenomenon of dynamic stall are also discussed.

I H

A85-49702#

A SIMPLE AND EFFECTIVE DIFFERENCE SCHEME IN AERODYNAMICS

D FU and Y MA (Beijing Institute of Aerodynamics, People's Republic of China) Acta Aerodynamica Sinica, no 3, 1985, p 15-23. In Chinese, with abstract in English.

The usual explicit difference schemes in aerodynamics are modified by the addition of a supplementary difference operator. The techniques used in obtaining the new schemes are as simple and easy to manipulate as the original explicit difference schemes but require large time steps for computation in the case of a full implicit scheme. The method is applied to solve 2-D shock wave boundary layer interaction problem. The computed result is compared with experiment and solutions of implicit MacCormack scheme. Numerical experiments show that the developed scheme is effective.

Author

A85-49703#

VARIATIONAL PRINCIPLE FAMILIES FOR HYBRID PROBLEMS OF BLADE-TO-BLADE FLOW ALONG AXISYMMETRIC STREAM-SHEET - A UNIFIED VARIABLE-DOMAIN APPROACH

G LIU (Shanghai Institute of Mechanical Engineering, People's Republic of China) Acta Aerodynamica Sinica, no 3, 1985, p 24-33. In Chinese, with abstract in English. refs

The mathematical tool of functional variations with variable domain is used to develop a new unified theory of various hybrid problems of blade-to-blade flow. Natural boundary conditions and artificial interface are taken into account, as are distributed mass suction and/or injection along the blade surface. A new and sound theoretical basis for FEM and other variational methods, as well as a series of new methods for blade design and modification, are presented. This theory also constitutes an important part of the optimization theory of bladings and can be extended to S2 stream surface flow, fully 3-D flow, and wing design or modification.

C D

A85-49705#

THE ROLLING VORTEX-DAMPING OF SUPERSONIC WING

H YAN (Northwestern Polytechnical University, Xian, People's Republic of China) Acta Aerodynamica Sinica, no 3, 1985, p 45-53. In Chinese, with abstract in English. refs

Based on the separated vortex field of the wing and vortex lifetime theory, theoretical formulas for the rolling vortex damping of a supersonic wing due to separated vortex of low aspect ratio sharp-edged wings under roll and angle attack are derived using supersonic linear theory. Two terms are included in the roll vortex damping, one proportional to the product of attack angle and roll rate, the other proportional to the square of the roll rate. A new

theoretical calculation model of roll damping is presented. Values for the rolling damping factor with various combination parameters of the wing planforms are given, and some comparisons between this method and prevalent potential theory are made. C D

A85-49706#

RESEARCH ON IMPLICIT APPROXIMATE-FACTORIZATION FINITE-DIFFERENCE METHOD FOR THE EULER EQUATION

F LIU (Northwestern Polytechnical University, Xian, People's Republic of China), Y WEI, and T. MAI (Beijing Institute of Aeronautics and Astronautics, People's Republic of China). Acta Aerodynamica Sinica, no 3, 1985, p 54-62. In Chinese, with abstract in English. refs

An implicit approximate-factorization finite difference method is presented and used to calculate a number of two-dimensional steady flow problems typical in computational fluid dynamics, including (1) subsonic, supersonic, and transonic flows in a straight divergent nozzle, (2) supersonic flows past an infinite wedge and a symmetric double wedge airfoil, and (3) subsonic, transonic, and supersonic flows past the NACA 0012 airfoil. The method treats strong shocks correctly, automatically satisfies the Kutta condition, and permits the use of Courant numbers greater than one so that the computation is accelerated. Both analysis and computation are carried out in body-fitted coordinate systems. The method can be extended to the calculation of three-dimensional problems. C D

A85-49707#

A CALCULATING METHOD OF THE BREAKDOWN FEATURE OF THE LEADING-EDGE SEPARATING VORTEX FOR SLENDER DELTA WINGS

B LIN (Beijing Institute of Aerodynamics, People's Republic of China). Acta Aerodynamica Sinica, no 3, 1985, p 63-71. In Chinese, with abstract in English. refs

A double layer mode was established, which can be used to describe the separating vortex flow over the delta wing leading-edge. The inner layer of this double layer mode is the vortex core and outer layer is the nonrotational potential flow, both these provide the initial and outer edge conditions which are necessary for solving vortex core development. In the incompressible flow the method not only can compute the initial breakdown angles of attack, but also can compute the breakdown points along the line of the root chord when the angles of attack is more than the critical ones. The theoretical results agree with the experiment measures well and show that the breakdown points are independent of the Reynolds number. Author

A85-49708#

ON ROLLING RESONANCE AND SMALL ASYMMETRICAL AERODYNAMIC FORCE OF RE-ENTRY BODY

J CAI (China Aerodynamics Research and Development Center, People's Republic of China). Acta Aerodynamica Sinica, no 3, 1985, p 72-81. In Chinese, with abstract in English. refs

The rolling resonance of a reentry body is discussed from a flight mechanical and aerodynamical standpoint, and the divergence of the angle of attack of the reentry body is analyzed. It is shown that rolling resonance is a primary hazard for the reentry body. It is suggested that the determination of random ablative configurations and the corresponding mathematical expectations and variances of small asymmetrical aerodynamic coefficients are key problems in the prediction of rolling resonance probability for a reentering body. C D

A85-49710#

ANALYTICAL SOLUTIONS FOR UNSTEADY PRANDTL-MEYER FLOW

J CHEN and J HUO (Nanjing Aeronautical Institute, People's Republic of China). Acta Aerodynamica Sinica, no 3, 1985, p 96-101. In Chinese, with abstract in English. refs

Using the frequency perturbation method analytical solutions for unsteady Prandtl Meyer flow are obtained, which consist of a series including up to the fifth power of the frequency. The solutions are held to the expansive surface of a two dimensional

supersonic/hypersonic flat wings oscillating harmonically in pitching for the small amplitude and low frequency at arbitrary angle of attack. The contributions of higher power frequency terms of the frequency are analyzed, based on the numerical results in this paper. Author

A85-49874

THE AERODYNAMIC CHARACTERISTICS OF A GU25-5(11)8 AEROFOIL FOR LOW REYNOLDS NUMBERS

R A MCD GALBRAITH (Glasgow, University, Scotland). Experiments in Fluids (ISSN 0723-4864), vol 3, no 5, 1985, p 253-256. refs

Wind tunnel test results are presented for the GU25-5(11)8 airfoil, most commonly used on canard microlights and characterized as a high-lift low-drag airfoil. Data were obtained for the Reynolds number range of 50,000 to 610,000, corresponding to the transition from a laminar separation flow with no reattachment to a fully attached and turbulent flow. Severe performance degradation is reported for the Re (based on freestream velocity and airfoil chord) lower than 300,000. Furthermore, oil flow pattern at the wall/airfoil junction exhibits corner boundary separation before the main airfoil separation bubble, resulting in a strong standing vortex. L T

A85-50104

THE ANALYSIS OF COUNTER-ROTATING PROPELLER SYSTEMS

D J LESIEUTRE and J P SULLIVAN (Purdue University, West Lafayette, IN). SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985. 14 p. refs (SAE PAPER 850869)

A vortex lattice method for the aerodynamic analysis of counter-rotation propellers was developed. This model along with an unsteady Sears analysis for correcting the quasi-steady loadings that are obtained from the vortex lattice model were used to predict the performance of counter-rotation propeller systems. The method developed shows good correlation with experimental results. The investigation into the unsteady loadings on each of the propellers indicates that significant variations in loading occur due to the unsteady flow and due to the propeller blade passage. These variations were found to be as high as 17 percent of the mean value. The parametric studies that were performed indicate that reducing the rear propeller's diameter or rotational speed results in a loss of efficiency. Author

A85-50105*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

LASER VELOCIMETER MEASUREMENTS OF THE FLOW FIELDS AROUND SINGLE- AND COUNTER-ROTATION PROPELLER MODELS

D M DUNHAM, W L SELLERS, III (NASA, Langley Research Center, Hampton, VA), and J W ELLIOTT (U.S. Army, Structures Laboratory, Hampton, VA). SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985. 9 p (SAE PAPER 850870)

A two-component LV system was used to make detailed measurements of the flow field around both a single-rotation and a counter-rotation propeller/nacelle. The conditions measured for the single-rotation tractor configuration include two different blade angles and two propeller advance ratios, and for the counter-rotation propeller configuration include both pusher and tractor mounts. The measurements show the increasing slipstream velocities and contraction with increasing blade angle and with decreasing advance ratios. Data for the counter-rotation system show that the aft propeller turns the flow in the opposite direction from the front propeller. Additionally, the LV system was used as a diagnostic tool to provide data to explain the large side force measured on the propeller/nacelle at angle-of-attack. Author

02 AERODYNAMICS

N85-50106* National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
NOISE CONSTRAINTS EFFECTING OPTIMAL PROPELLER DESIGNS

C J MILLER (NASA, Lewis Research Center, Cleveland, OH) and J P SULLIVAN (Purdue University, West Lafayette, IN) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 11 p Previously announced in STAR as N85-19923 refs
(SAE PAPER 850871)

A preliminary design tool for advanced propellers was developed combining a fast vortex lattice aerodynamic analysis, a fast subsonic point source noise analysis, and an optimization scheme using a conjugate directions method. Twist, chord and sweep distributions are optimized to simultaneously improve both the aerodynamic performance and the noise observed at a fixed relative position. The optimal noise/performance tradeoffs for straight and advanced concept blades are presented. The techniques used include increasing the blade number, blade sweep, reducing the rotational speed, shifting the spanwise loading and diameter changes
E A K

N85-34114*# Scientific Research Associates, Inc., Glastonbury, Conn

A THREE-DIMENSIONAL VISCOUS FLOW ANALYSIS FOR THE HELICOPTER TIP VORTEX GENERATION PROBLEM Final Report

S J LIN, R LEVY, S J SHAMROTH, and T R GOVINDAN
Washington NASA Aug 1985 69 p refs
(Contract NAS1-14904)
(NASA-CR-3906, NAS 1 26 3906) Avail NTIS HC A04/MF A01 CSCL 01A

The tip vortex flow field occurring in the vicinity of the tip region of a helicopter rotor blade is a very complicated three-dimensional, viscous flow phenomenon. The details of the flow in the tip region can have a major effect in determining the generated rotor noise and can significantly affect the performance and dynamic loading of the rotor blade. The three-dimensional viscous subsonic tip vortex generation processes is investigated by a numerical procedure which allows spatial forward-marching integration, utilizing flow approximations from the velocity-decomposition approach of Briley and McDonald. The approach has been applied to compute the laminar and turbulent tip vortex flows for a constant thickness slab airfoil with a square tip, a constant thickness slab airfoil with a half round tip and a NACA 0012 airfoil with a half round tip. The basic mechanism of the tip vortex generation process as well as the prediction of vortex appearance, strength and secondary flow shown by the calculations are in qualitative agreement with experimental results
Author

N85-34115*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif

AN EVALUATION OF THREE HELICOPTER ROTOR SECTIONS

R M HICKS and L J COLLINS (Informatics General Corp., Palo Alto, Calif) Aug 1985 122 p refs
(NASA-TM-86719, REPT-85219, NAS 1 15 86719) Avail NTIS HC A06/MF A01 CSCL 01A

Three helicopter rotor sections were tested in the NASA Ames Research Center 2- by 2-Foot Transonic Wind Tunnel over a Mach range from 0.2 to 0.88. The sections tested had maximum thickness/chord ratios of 0.078, 0.09, and 0.10. The thickest section was of early technology and had been tested previously in other wind tunnels. This section was included in the investigation to establish a basis for comparing the two thinner sections, which were of recent design. The results of the investigation showed that the pitching-moment characteristics for the three airfoil sections were acceptable. The drag divergence Mach numbers for the three sections were 0.80, 0.825, and 0.845 in order of decreasing thickness
Author

N85-34116*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif

USE OF A HYPERBOLIC GRID GENERATION SCHEME IN SIMULATING SUPERSONIC VISCOUS FLOW ABOUT THREE-DIMENSIONAL WINGED CONFIGURATION

Y M RIZK (Informatics General Corp., Palo Alto, Calif), J L STEGER, and D S CHAUSSEE Jul 1985 16 p refs
(NASA-TM-85344, REPT-85344, NAS 1 15 85344) Avail NTIS HC A02/MF A01 CSCL 01A

The present paper describes a numerical mesh generation technique to be used with an implicit finite difference method for simulating viscous supersonic flow about low-aspect-ratio wing body configurations using a single grid strategy. The computational domain is segmented into multiple regions, with borders located in supersonic areas to avoid the otherwise costly interfacing procedure between adjacent segments. The numerical procedure is applied to calculate the turbulent flow around the shuttle orbiter and a canard projectile at supersonic free stream Mach number
Author

N85-34120# Glasgow Univ (Scotland) Dept of Aeronautics and Fluid Mechanics

A DESIGN PROCEDURE TO MODIFY THE TRAILING EDGE UPPER SURFACE PRESSURE GRADIENT OF A GIVEN AEROFOIL

A J NIVEN and R A M GALBRAITH 10 Jul 1984 29 p refs
Sponsored by Westlands Helicopters Public Ltd Company and UK Science and Engineering Research Council
(GU-AERO-8408) Avail NTIS HC A03/MF A01

A method whereby the pressure gradient on the trailing edge upper surface of a given airfoil may be modified to enhance or reduce trailing-edge separation during dynamic stall, for a given section, while retaining the leading edge pressure distribution, is outlined. The NACA 23012 airfoil was modified to enhance the boundary layer separation at the trailing-edge. The modification procedure consists of three algorithms: a potential flow panel method allowing calculation of the original pressure gradient at any angle of attack, a procedure allowing the modification of this gradient, and an inverse potential flow panel method to calculate a new profile from the modified vorticity distribution
Author (ESA)

N85-34121# Glasgow Univ (Scotland) Dept of Aeronautics and Fluid Mechanics

THE AERODYNAMIC CHARACTERISTICS OF A GU25-5(11)8 AEROFOIL FOR LOW REYNOLDS NUMBERS

R A M GALBRAITH 8 Nov 1984 11 p refs
(GU-AERO-8410) Avail NTIS HC A02/MF A01

Wind tunnel tests of an airfoil section used for the canards of microlights where low Reynolds numbers are common, over the Reynolds number range 50,000 to 610,000 are summarized. The airfoil exhibits severe degradation of performance below $Re = 300,000$, a phenomenon known to be quite general
Author (ESA)

N85-34122# Glasgow Univ (Scotland) Dept of Aeronautics and Fluid Mechanics

MODELLING OF UNSTEADY, INCOMPRESSIBLE SEPARATION ON AN AEROFOIL USING AN INVISCID FLOW ALGORITHM

M VEZZA and R A M GALBRAITH 8 Nov 1984 33 p refs
(GU-AERO-8412) Avail NTIS HC A03/MF A01

A method for the prediction of unsteady, incompressible separated flow over a two dimensional airfoil is presented. The algorithm was developed from an unsteady potential flow model and uses an inviscid formulation for the flow field. The airfoil is represented by vortex panels of linearly varying strength, piecewise continuous at the corners. Discrete vortices with finite cores are used to model the separating shear layers. Unsteady separation modeling, the theoretical framework, and numerical implementation are discussed. Results for flows which tend asymptotically to the steady state are encouraging
Author (ESA)

N85-34123# Glasgow Univ (Scotland) Dept. of Aeronautics and Fluid Mechanics
THE COLLECTED DATA FOR RAMP FUNCTION TESTS ON A NACA 23012 AEROFOIL VOLUME 1: DESCRIPTION AND PRESSURE DATA

L Y SETRO and R A M GALBRAITH 8 Nov 1984 58 p refs Sponsored by Westlands Helicopters Public Ltd Company (Contract MIN-DEF-2048/O26XR/STR)
 (GU-AERO-8413-VOL-1) Avail NTIS HC A04/MF A01

Data for wind tunnel tests in which a NACA 23012 airfoil was subjected to a variety of ramp type displacements in pitch about the quarter chord position are presented. The data clearly illustrate the effect of reduced frequency on airfoil characteristics and the chordal pressure distribution at the midspan position of the airfoil model
 Author (ESA)

N85-34124# Glasgow Univ (Scotland) Dept of Aeronautics and Fluid Mechanics
AN INVESTIGATION INTO THE THREE-DIMENSIONAL STALL DEVELOPMENT ON A MODIFIED NACA 23012 AEROFOIL

A J NIVEN and R A M GALBRAITH 22 Nov 1984 19 p refs Sponsored by United Kingdom Science and Engineering Research Council
 (Contract MIN-DEF-2048/O26XR/STR)
 (GU-AERO-8414) Avail NTIS HC A02/MF A01

A numerical method of modifying the trailing edge upper surface pressure gradient of a given airfoil was applied to the NACA 23012 airfoil to enhance the trailing edge pressure gradient. The redesigned airfoil was tested in a subsonic wind tunnel. A flow visualization technique, using a fluorescent yellow oil-film, was used to indicate transition regions, laminar separation bubbles, and the positions of turbulent separation. The extent of three-dimensionality, reverse flow, and corner flow separation were also observed. Results show increased boundary layer separation of the modified airfoil, and vindicate the design method
 Author (ESA)

N85-34125# Glasgow Univ (Scotland)
COMMENTS ON THE PREDICTION OF DYNAMIC STALL

R A M GALBRAITH 20 Mar 1985 25 p refs
 (Contract DAJA45-84-M-0446)
 (GU-AERO-8501) Avail NTIS HC A02/MF A01

Navier-Stokes, discrete vortex, zonal, and empirical methods for predicting dynamic stall were reviewed. It is concluded that accepted test cases by which the performance of dynamic stall methods may be assessed are needed. There is an unresolved dilemma as to which basic prediction philosophy should be adopted. Using the appropriate form of the Navier-Stokes equations in finite difference form requires large and expensive computing power, while the predominantly empirical procedures need little of such power but much expensive data. A summary table provides a quick reference to the methods
 Author (ESA)

N85-34126# Aeronautical Research Inst of Sweden, Stockholm Aerodynamics Dept
AEROELASTIC CONSTRAINTS FOR A WING WEIGHT MINIMIZATION PROCEDURE

S G HEDMAN Feb. 1985 17 p refs
 (Contract STU-81-4626)
 (FFA-TN-1985-4) Avail NTIS HC A02/MF A01

Basic formulas of aeroelastic relations for use as constraints in a wing weight optimization procedure are derived. Steady subsonic or supersonic flow is assumed, and a reference plane panel method is chosen as the aerodynamic load generator. Wing elastic deformation is assumed to be a linear function of the applied loads. The effect of changing the amount of wing material for each wing panel on the deformation properties is used in expressions for aeroelastic efficiency and induced drag. The formulas were successfully implemented for a high aspect ratio wing application
 Author (ESA)

N85-34127# Institut Franco-Allemand de Recherches, St Louis (France)

A COMPARISON OF LASER DOPPLER ANEMOMETRY AND PROBE MEASUREMENTS WITHIN THE BOUNDARY LAYER OF AN AIRFOIL AT SUBSONIC FLOW

P MEYER, G KOERBER, H HOHEISEL (DFVLR, Brunswick), and M HOEGER (DFVLR, Brunswick) 3 Sep 1984 18 p refs Presented at 2nd Intern Symp on Appl of Laser Anemometry to Fluid Mech, Lisbon, 2-4 Jul 1984
 (Contract DFVLR-IB-129-84/5)
 (ISL-CO-219/84) Avail NTIS HC A02

Measurements were performed with a Pitot probe and a laser Doppler anemometer in the boundary layer of a NACA 65-213 airfoil with a separation bubble on the suction side. Comparison of the results shows good agreement for attached laminar and turbulent boundary layers, at the separation point, and in the laminar separated region except for reverse flow. Differences between the two techniques are observed only near the reattachment point in flow areas with steep pressure gradients, where the presence of the probe may lead to disturbances in the flow field. The importance of a laminar separation bubble for the improvement of cascade flow and airfoils is discussed
 Author (ESA)

N85-34128# Institut Franco-Allemand de Recherches, St Louis (France)

STUDY OF BOUNDARY LAYER SEPARATION ON A SUPERCRITICAL PROFILE WITH A SPOILER BY MEANS OF A LASER DOPPLER VELOCIMETER

P MEYER and G KOERBER 3 Sep 1984 8 p refs Presented at 2nd Intern Symp on Appl of Laser Anemometry to Fluid Mech, Lisbon, 2-4 Jul 1984
 (Contract DRET-82-318)
 (ISL-CO-225/84) Avail NTIS HC A02

A supercritical airfoil with a spoiler was studied by a two-dimensional laser Doppler velocimeter. Local and global mean velocity and shear evolutions are presented. Two different separation models can be observed as a function of the spoiler deflection angle: a separated region with one recirculating area (angle of 10 deg), a separated region with areas (angle of 20 and 40 deg). Flow visualizations show a Karman vortex street behind the spoiler. Boundary layer displacement and momentum thickness deduced from the measurements agree with calculations
 Author (ESA)

N85-35156 North Carolina State Univ, Raleigh
A STREAM FUNCTION APPROACH TO SOLVING THE CONSERVATIVE EULER EQUATIONS FOR TRANSONIC FLOWS Ph.D. Thesis

H L ATKINS 1984 121 p
 Avail Univ Microfilms Order No DA8506981

An approach to obtaining steady state solutions to the conservative Euler equations in two dimensions is presented. The approach makes use of the adiabatic assumption, and employs the stream function and the density as dependent variables, thus eliminating one equation and one unknown. The present approach is implemented in two different ways. In the first method, the conservative Euler equations are recast in terms of the density and the stream function to yield a system of two partial differential equations. The resulting equations are stiff, and hence, are solved by a fully implicit method for a geometrically simple internal flow problem. In the second method, the partial differential equation for density is replaced by an algebraic relation. Thus the resulting formulation involves solving one second order partial differential equation for the stream function. The second method is applied to airfoils at transonic speeds
 Dissert Abstr

02 AERODYNAMICS

N85-35161*# National Aeronautics and Space Administration, Washington, D C

PRESENTATION OF THE ACOUSTIC AND AERODYNAMIC RESULTS OF THE ALADIN 2 CONCEPT QUALIFICATION TESTING

M COLLARD, C DOYOTTE, and M SAGNER Jul 1985 30 p refs Transl into ENGLISH of Presentation des Resultats Aerodyn et Acoust des Essais de Qualification du Concept Aladin 2, (France), in AGARD CP-143, Apr 1974 10 p Original language doc was announced in IAA as A75-13803 Transl by Scientific Translation Services, Santa Barbara Calif Original doc prep by Bertin and Cie Company (Contract NASW-4004) (NASA-TM-77883, NAS 1 15 77883, CP-143) Avail NTIS HC A03/MF A01 CSCL 01A

Wind tunnel tests were conducted of a scale model of the Aladin 2 aircraft The propulsion system configuration is described and the air flow caused by jet ejection is analyzed Three dimensional flow studies in the vicinity of the engine installation were made Diagrams of the leading and trailing edge flaps are provided Graphs are developed to show the aerodynamic performance under conditions of various airspeed and flap deflection Author

N85-35162*# Douglas Aircraft Co., Inc., Long Beach, Calif
CALCULATION OF COMPRESSIBLE FLOW ABOUT THREE-DIMENSIONAL INLETS WITH AUXILIARY INLETS, SLATS AND VANES BY MEANS OF A PANEL METHOD Final Contractor Report, 17 Feb. 1983 - 15 Aug. 1985

J L HESS, D M FRIEDMAN, and R W CLARK Jun 1985 197 p refs (Contract NAS3-22250) (NASA-CR-174975, NAS 1 26 174975, MDC-J3789) Avail NTIS HC A09/MF A01 CSCL 01A

An efficient and user oriented method was constructed for calculating flow in and about complex inlet configurations Efficiency is attained by (1) the use of a panel method, (2) a technique of superposition for obtaining solutions at any inlet operating condition, and (3) employment of an advanced matrix iteration technique for solving large full systems of equations, including the nonlinear equations for the Kutta condition User concerns are addressed by the provision of several novel graphical output options that yield a more complete comprehension of the flowfield than was possible previously E A K

N85-35171# European Space Agency, Paris (France)
ESTIMATION OF FLIGHT MECHANICAL VARIABLES BY MEANS OF KALMAN FILTERS

E PLAETSCHKE In its Lectures of a Flight Mech Conf (DFVLR-Mitt-83-05) p 80-92 Jul 1984 refs Transl into ENGLISH from "Vortraege eines Flugmechanik-Kolloquiums" rept DFVLR-Mitt-83-05 DFVLR, Brunswick, Jul 1983 p 85-99 Original language document was announced as N84-16126 Avail NTIS HC A06/MF A01, original German version available from DFVLR, Cologne DM 39 20

A data evaluation system was developed to estimate flight-mechanical characteristics The measurements concern specific aerodynamic forces, angular velocities, and air data (flight velocity, angle of attack, and sliding angle) The measurement data are incompatible due to zero point drift, false calibrations, and noise The data evaluation system uses the redundancy between the data through the equations or motion to estimate the errors, resulting in a compatible set of data The state variables are Kalman filter estimated Author (ESA)

N85-35173# Naval Postgraduate School, Monterey, Calif
ANALYSIS OF INCOMPRESSIBLE CASCADE FLOWS USING STATE-OF-THE-ART COMPUTER PROGRAMS M.S. Thesis
P E GENSKOW Mar 1985 65 p (AD-A155850) Avail NTIS HC A04/MF A01 CSCL 09B

Two state-of-the-art computer programs, Q3DFLOW and a standard Cebeci boundary layer program as applied to aerodynamic flows in a cascade are examined Q3DFLOW is a quasi

three-dimensional finite element turbomachinery program Only the incompressible blade-to-blade module of this program is used The Cebeci boundary layer program is for incompressible, two dimensional, and constant viscosity flows It is used to calculate boundary layers on a few isolated airfoils and airfoils/blades in a cascade Experimental data and other analytical computations are compared for both programs Additionally, the theory and operation of the Cebeci boundary layer program are presented GRA

N85-35174# Naval Postgraduate School, Monterey, Calif
THE INFLUENCE OF HELICOPTER TAIL SHAPE ON DRAG: AN AERODYNAMIC STUDY USING A LOW SPEED WIND TUNNEL M.S. Thesis

C L SARGENT Mar 1985 91 p (AD-A156304) Avail NTIS HC A05/MF A01 CSCL 20D

This thesis examines the effect of helicopter tail shape on drag using a low speed wind tunnel at the Naval Postgraduate School A modification to the Aeronautical Engineering Department's 3 5 ft x 5 ft wind tunnel was made to update facilities and allow this work Major R Scott Mair worked simultaneously to study the effect of nose shape on drag, a result of the 2-man requirement for wind tunnel work The existing external balance was replaced with an internal balance and a variable angle-of-attack support system was constructed as well Quantitative data was collected with this balance, and qualitative information was obtained by tufting the models and visualizing the airflow The equipment built was adequate with the exception of one component of the balance, which will require a new balance to be built This single deficiency was significant enough to invalidate the output of the balance and as a result any quantitative discussion of how a helicopter's tail shape affects drag Without this data the explanation of drag using flow visualization is also not practical GRA

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations, and aircraft accidents

A85-47259#
E AND H FIELDS MEASUREMENTS ON THE TRANSALL C160 AIRCRAFT DURING LIGHTNING FLASHES

J P MOREAU and J C ALLIOT (ONERA, Chatillon-sous-Bagneux, France) (International Conference on Lightning and Static Electricity, Paris, France, June 10-12, 1985) ONERA, TP, no 1985-48, 1985, 8 p refs (ONERA, TP NO 1985-48)

An airborne experiment was carried out to study the microphysical, dynamic, and thermodynamic properties of frontal systems and to determine the main parameters of electrical and electromagnetic phenomena associated with cloud discharges It is found that a lightning flash lasts several hundred milliseconds and that there are two kinds of flashes, i.e., those beginning with a train of pulses lasting milliseconds and followed by solitary pulses (75 percent of the cases) and those beginning with solitary pulses Typical E and H field waveforms for the duration of the flashes, recorded with a 2-MHz-bandwidth analog device, are presented, as are E and H waveforms obtained with 100-MHz-bandwidth transient digitizers and electromagnetic transfer functions of a well defined aperture installed on the aircraft fuselage V L

A85-47684* Analytical Mechanics Associates, Inc., Mountain View, Calif.

THE FLIGHT PLANNING - FLIGHT MANAGEMENT CONNECTION

J. A. SORESEN (Analytical Mechanics Associates, Inc., Mountain View, CA) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 174-178 refs
(Contract NAS1-17345)

Airborne flight management systems are currently being implemented to minimize direct operating costs when flying over a fixed route between a given city pair. Inherent in the design of these systems is that the horizontal flight path and wind and temperature models be defined and input into the airborne computer before flight. The wind/temperature model and horizontal path are products of the flight planning process. Flight planning consists of generating 3-D reference trajectories through a forecast wind field subject to certain ATC and transport operator constraints. The interrelationships between flight management and flight planning are reviewed, and the steps taken during the flight planning process are summarized. Author

A85-48861

THE GROWING IMPACT OF GENERAL AVIATION ON THE WORLD'S AVIATION SYSTEM

D. W. FREER (International Civil Aviation Organization, Air Navigation Bureau, Montreal, Canada) ICAO Bulletin, vol 40, June 1985, p 12-16

Of the world's more than 300,000 total general aviation (GA) aircraft, over three quarters are registered in North America. The growing numbers of GA fixed-wing and rotary-wing aircraft in the past decade, and the forecasts made by the FAA, the Aerospatiale, and Sikorsky Aircraft have disclosed trends towards escalation in growth, as well as towards increasing sophistication of GA aircraft, with growing predominance of the multiengine piston, turboprop, and turbojet fixed-wing and rotary-wing aircraft. The pilots of GA aircraft will have increasingly extensive training and advanced rating. The GA fleet will account for an increasing percentage of total instrument flight operations, international operations, and, in particular, the number of civil helicopters. This growth in GA aircraft operations needs new standards, which are currently being prepared by the ICAO. New and additional international specifications are being drawn for GA, and additional airport facilities for GA aircraft are being developed. An array of statistical data for the period 1977-1995 is included. IS

A85-48862

AIRCRAFT ICING MUST NEVER BE UNDERESTIMATED

O. K. TRUNOV (Gosudarstvennyi Nauchno-Issledovatel'skii Institut Grazhdanskogo Vozdushnogo Flota, Moscow, USSR) ICAO Bulletin, vol 40, June 1985, p 17-21

Underrating by the aircraft crew of the hazards of ice formed on the ground is one of the principal factors of ice-related accidents. A study conducted in the framework of Soviet-Swedish technical cooperation revealed quantitative relationships between the extent and geometry of ice covering and the coefficient of lift and the angle of attack, and underscored the necessity of complete ice removal from the aircraft surface before and during takeoff. The most effective current protection in both removing and preventing further accretion of ice is offered by anti- and de-icing fluids. Correct and timely application of anti-icing fluids and mechanical de-icing devices, and continuous supervision of the state of the aircraft up to the moment of take off are discussed, together with the necessary variations in these precautions demanded by different weather and ground conditions. IS

A85-49130*# Jet Propulsion Lab., California Inst of Tech., Pasadena

POOL FIRE-VENTILATION CROSSFLOW EXPERIMENTS IN A SIMULATED AIRCRAFT CABIN INTERIOR

C. P. BANKSTON and L. H. BACK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p 861-868
NASA-supported research refs

An experimental facility has been built to study pool fire dynamics and flame spread behavior in a 1/3-scale simulated aircraft interior, attention is presently given to pool fire ventilation crossflow using a 'channel' pool fire subjected to crossflow velocities that replicate postcrash conditions in a wide body aircraft. Crossflow velocity is noted to have a strong effect on visible flame geometry, tilting the flame over sharply. A reverse flow ceiling jet of hot gases was also present in all tests, however, and extended far upstream of the fire, so that despite the appearance of the visible flame, the vertical momentum of the plume was strong enough to establish the reverse flow layer and spread smoke and toxic gases upstream against a significant ventilating flow. OC

A85-49140#

A NONLINEAR SOLUTION FOR PARACHUTE SUSPENSION LINE DEFORMATION

E. W. ROSS, JR (U.S. Army, Aeromechanical Engineering Laboratory, Natick, MA) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p 925, 926 refs

In the present elementary solution for the large, static deformations of a generic suspension line in a solid, flat, circular parachute configuration whose force distribution is similar to that transmitted from the adjacent fabric, the suspension line is idealized as a flexible, initially unstressed and straight string. The family of shapes obtained may be useful as a check on the correctness of the finite element code for the structural part of the calculation. OC

A85-49625

ADVANCED ESCAPE SYSTEMS

T. FORD (Martin-Baker /Engineering/, Ltd., Higher Denham, England) Aircraft Engineering (ISSN 0002-2667), vol 57, Aug 1985, p 6-10

In connection with the introduction of new aircraft, it is often necessary to extend the performance envelope of the escape system. Advances regarding the design and the operation of aviation escape systems are discussed, taking into account developments occurring as a result of work undertaken in response to the U.S. Navy Aircrew Common Ejection Seat (NACES) program. The seat modes of operation of a new escape system include a high-altitude mode, intermediate-altitude modes, and low altitude modes. Attention is given to the mode selector, the Automatic Inflation Modulation (AIM) personnel parachute, the rigid survival kit, the Parachute Deployment Rocket (PDR), an illustration of the high-altitude ejection sequence, and the features of the NACES seat. GR

A85-49907

HANDHELD COMPUTER WEIGHT AND BALANCE COMPUTATIONS FOR MILITARY AIRCRAFT

L. J. BRENNER (Horizons Technology, Inc., San Diego, CA) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984, 8 p
(SAWE PAPER 1582)

An aircraft Weight and Balance Computer (WABC), easy to operate, and allowing considerable flexibility on types of loads and their location, is described. The WABC has two basic modes. In the initial mission planning (Mode I) the user is asked to consider all applicable inputs in terms of weight and moment of the individual tank quantities, cargo, and passengers. Once all the inputs are displayed, the user may adjust his previous inputs (Mode II). This mode will greatly simplify the adjustments by allowing changes in the load in any fuel tank or any compartment without reentering the rest of the original values. After the 'Review All' step, the WABC will step through all the entries required on the Form F,

03 AIR TRANSPORTATION AND SAFETY

and, if a printer is available, print the Form F for submission prior to take-off IS

N85-34130# Committee on Public Works and Transportation (U S House)

AVIATION SAFETY (AIRCRAFT PASSENGER SURVIVABILITY AND CABIN SAFETY)

Washington GPO 1985 780 p refs Hearings before the Subcomm on Invest and Oversight of the Comm on Public Works and Transportation, 98th Congr, 1st Sess, 12-14 Jul and 1-2 Nov 1983

(GPO-39-847) Avail Subcommittee on Investigations and Oversight

Various issues relative to the survival of aircraft passengers are discussed Aircraft construction materials, firefighting, fireproofing, toxic hazards, fire extinguishers and emergency life sustaining equipment are among the topics discussed R J F

N85-35169# European Space Agency, Paris (France)

THE CONTRIBUTION MADE BY FLIGHT MECHANICS TO CIVIL AVIATION

P HAMEL *In its* Lectures of a Flight Mech Conf (DFVLR-Mitt-83-05) p 42-58 Jul 1984 Transl into ENGLISH from "Vortraege eines Flugmechanik-Kolloquiums" rept DFVLR-Mitt-83-05 DFVLR, Brunswick, Jul 1983 p 47-64 Original language document was announced as N84-16124

Avail NTIS HC A06/MF A01, original German version available from DFVLR, Cologne DM 39 20

Flight mechanical problems of the pilot-aircraft system due to the introduction of new technologies are discussed These technologies (e.g., active control technology) are used to reduce fuel costs Research on an evaluating improving flight characteristics using an Airbus in-flight simulator is discussed

Author (ESA)

N85-35175# Air Force Inst of Tech, Wright-Patterson AFB, Ohio

INVESTIGATION OF EXPERIMENTAL LIGHTWEIGHT FIREWALL MATERIALS FOR A/C ENGINE BAY APPLICATIONS Final Report, 1 Oct. 1983 - 2 May 1984

J J MOYER Wright-Patterson AFB, Ohio AFWAL Apr 1985 119 p

(AD-A155765, AFWAL-TR-84-2082) Avail NTIS HC A06/MF A01 CSDL 11G

An evaluation of fire-resistant materials was conducted to identify possible replacements for stainless steel for use as aircraft firewalls The materials were subjected to the standard firewall (MIL-I-83294), fire-penetration test In addition, each sample passing this test was further evaluated on weight, thermal protection, and maintenance requirements An attempt was made to correlate physical properties to fire penetration test performance, but was not successful due to the lack of physical property information The report identifies those materials which should be developed for use as firewalls and fire-hardening materials on the aircraft

Author (GRA)

N85-35176# Air Command and Staff Coll, Maxwell AFB, Ala **INTRODUCTION TO EUROPEAN AIR TRAFFIC CONTROL**

I J HAYES Apr 1985 51 p

(AD-A156328, ACSC-85-1095) Avail NTIS HC A04/MF A01 CSDL 17G

The Strategic Air Command's authoritative source for instrument flight procedures, SAC Instrument Flight Course (SIFC), has no comprehensive vehicle with which to introduce the European flight environment to crews that may deploy into the unfamiliar airspace The study acquaints the reader with the overall nature of flying in the European theater and introduces some procedural differences The study also looks at how the European system is organized, by examining the airspace structure The study concludes with a look at the military/civilian dichotomy of airspace control in Europe

GRA

N85-35177# Air Command and Staff Coll, Maxwell AFB, Ala
INTERNATIONAL FLIGHT PLANNING HANDBOOK

H J GARVIN Apr 1985 71 p

(AD-A156330, ACSC-85-0915) Avail NTIS HC A04/MF A01 CSDL 01B

This handbook has been developed to instruct pilots and navigators on basic planning procedures and operations within the international environment It provides a consolidated source of information to facilitate planning for international flights The handbook is developed in four chapters covering (1) an overview of the international environment, followed by checklists with item-by-item amplification of, (2) pre-flight planning, (3) enroute operations, and (4) services and facilities at foreign destinations

GRA

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft, air navigation systems (satellite and ground based), and air traffic control

A85-47683* National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif
CONCEPTS AND ALGORITHMS FOR TERMINAL-AREA TRAFFIC MANAGEMENT

H ERZBERGER and J D CHAPEL (NASA, Ames Research Center, Moffett Field, CA) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 166-173 refs

The nation's air-traffic-control system is the subject of an extensive modernization program, including the planned introduction of advanced automation techniques This paper gives an overview of a concept for automating terminal-area traffic management Four-dimensional (4D) guidance techniques, which play an essential role in the automated system, are reviewed One technique, intended for on-board computer implementation, is based on application of optimal control theory The second technique is a simplified approach to 4D guidance intended for ground computer implementation It generates advisory messages to help the controller maintain scheduled landing times of aircraft not equipped with on-board 4D guidance systems An operational system for the second technique, recently evaluated in a simulation, is also described

Author

A85-47686* National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif
SIMULATION OF TIME-CONTROL PROCEDURES FOR THE ADVANCED AIR TRAFFIC CONTROL SYSTEM

L TOBIAS (NASA, Ames Research Center, Moffett Field, CA) and P J OBRIEN (FAA, Technical Center, Atlantic City, NJ) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 185-190 refs

The problem of mixing four-dimensional (4D) equipped aircraft - aircraft equipped with on-board guidance systems that can predict and control the touchdown time of an aircraft to an accuracy of a few seconds throughout the descent - with unequipped aircraft in the terminal area has been investigated via a real-time air traffic control simulation study The objective of this study was to examine the effect of time errors (at 120 n mi from touchdown) on touchdown time scheduling, and to develop efficient algorithms and procedures to null the initial time errors prior to reaching the final control sector (30 n mi from touchdown) Results indicate that initial random errors of up to + or - 2 min can be handled via a single speed advisory issued in the arrival control sector, and thus the time schedule is not disrupted

Author

A85-47687

TIME-CONTROLLED AIRCRAFT GUIDANCE IN UNCERTAIN WINDS AND TEMPERATURES

J W BURROWS and A CHAKRAVARTY (Boeing Co., Seattle, WA) IN. 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 191-197 refs

The design requirements on airborne equipment which controls an aircraft so it arrives at an assigned time are mainly driven by the need for satisfactory control during descent. Assuming open-loop control during a typical descent, the final altitude and arrival time errors due to unforecast winds and temperatures aloft are determined. The fuel required for closed-loop control to reduce these errors is given. Equations of motion, suitable for on-board nominal descent trajectory computation using descent area forecasts, are derived, including the effects of winds and temperatures. A sample descent trajectory, obtained by integrating these equations with an actual forecast, is given. The design of descent controllers using feedback of errors relative to the nominal trajectory is treated. The arrival time errors and fuel usage of such controllers for different gain choices and unforecast winds and temperatures are evaluated by simulation. Author

A85-48175

STATUS AND DEVELOPMENT TRENDS OF NAVIGATION SYSTEMS FOR GENERAL AVIATION [STAND AND ENTWICKLUNGSTENDENZEN VON NAVIGATIONSSYSTEMEN FUER DIE ALLGEMEINE LUFTFAHRT]

K HURRASS (DFVLR, Institut fuer Flugfuehrung, Brunswick, West Germany) Ortung und Navigation (ISSN 0474-7550), vol 26, no 2, 1985, p 240-251 In German refs

Technological advances related to the area of electronics have had a decisive effect on the development of navigation systems, taking into account the utilization of integrated components, microprocessors, and beam deflection tubes. A further growth in the volume of air traffic during the next 12 years is predicted, and safety requirements are expected to become still more demanding. It is therefore necessary to improve further the navigation systems for aviation with respect to navigation accuracy, reliability, and availability. The present paper is concerned with an evaluation of the merits and drawbacks of the currently employed navigation systems, giving attention to developments which will make it possible to meet future demands. The VOR/DME system is considered along with Non Direction Beacons (NDB), inertial navigation, area navigation, Doppler radar, the replacement of the ILS by the TRSB system, GPS, new display systems, and collision avoidance systems. G R

A85-48851

THE IMPOSITION OF FLOW CONTROL AVOIDS ATC OVERLOADS

C EIGL (International Civil Aviation Organization, Search and Rescue Section, Paris, France) ICAO Bulletin, vol 40, Feb 1985, p 13-16

The Air Traffic Flow Management (ATFM) unit was organized by the European Air Navigation Planning Group (EANPG) to ensure that an overload of the air traffic control (ATC) in the ATFM Region (which covers all Europe and has a USSR unit) does not occur, and that the traffic flow restrictions are minimized. The most important task of the ATFM is to establish early the anticipated high airspace and landing demand/ATC capacity ratio, and undertake specific action within either the strategic (early planning and coordination) or tactical, short-time measures. In practice, full use of the available ATC capacity is made on a local scale through the allocation of time slots to individual flights, and the adaptation of traffic flow into a given area. A truly regionwide coordination awaits full development of a reliable common data base, the Central Data Bank, which is now in its early phases of operation. This and other activities of the ATFM are planned and coordinated at the periodic EUR meeting of EANPG. I S

A85-48852

INITIAL EUROPEAN CENTRAL DATA BANK OF AIR TRAFFIC DEMAND NOW IN OPERATIONAL TRIALS

B MARTIN (EUROCONTROL, Brussels, Belgium) ICAO Bulletin, vol 40, Feb 1985, p 17-20

A Central Data Bank (CDB), established by the Air Traffic Flow Management (ATFM) Planning Group, is to provide the ATFM service in Europe with a common reference data base for a region-wide coordinated demand/capacity assessment among the air traffic control systems of the individual local areas of the member states. The system is serviced by two chains of equipment, each consisting of an IBM 4341 Central Processing Unit attached to an IBM computer used as communications controller. The output, will indicate where and when the traffic demand will reach or exceed specific ATC thresholds. The CDB data are held in the form of Flight Data Records, which provide aircraft identification, and the departure and destination airports. At its present, Phase I, stage, about 80 percent of calculated departures are found to coordinate with the arrivals. I S

A85-49094

RECONNOITERING THE ELECTROMAGNETIC SPECTRUM

M J KESSLER Defense Electronics (ISSN 0278-3479), vol 17, Sept 1985, p 107, 108, 110, 112, 114

New developments in signal intelligence (Sigint) systems are reviewed, with particular attention given to new Sigint aircraft, direction finding, and Elint collection. It is noted that advances in computer science, signal processing, and microcircuitry have led to miniaturization of equipment and increased automation of the airborne EW systems. Higher capability equipment for identifying and locating surface emitters not only permits construction of near real-time electronic order of battle for use in the C3I network but also enables immediate response for the suppression or destruction of perceived threats through the direction of an offensive strike from the Sigint platform. V L

A85-49096

INEWS IGNITES TECHNOLOGY TRADE-OFFS AND COMPETITION

J B SCHULTZ Defense Electronics (ISSN 0278-3479), vol 17, Sept 1985, p 136, 137, 139 (3 ff)

The goals of the phase of demonstration validation for the Integrated Electronic Warfare System (INEWS), the next-generation electronic warfare system for advanced fighter aircraft, are briefly reviewed. The major requirements for the INEWS are examined, and it is noted that the principal technological problem is combining the right mix of VHSIC components and other devices, such as those made of GaAs, into modular architectures that meet all the requirements for weight, space, reliability, and maintainability at a reasonable price. The problem of software is then examined, and goals for the next stages of the project are outlined. V L

A85-49171

AUTOMATION IN AIR TRAFFIC MANAGEMENT

S RATCLIFFE Journal of Navigation (ISSN 0020-3009), vol 38, Sept 1985, p 405-412 refs

ATC procedures are currently limited by the manpower-intensive nature of the work, the necessity for each ATC to find local solution instead of for the flight as a whole, and the practice of imposing standardized traffic patterns. Automating the critical ATC functions would require reliability at an expected accident potential of 1 in 1 billion. Computer hardware reliability could be assured with fault tolerant techniques. However, there is no experience base with the needed reliability which would be required of the real-time software required to handle the associated complex situations. Also, humans must be able to oversee the automatic processes. The FAA has announced intentions of automating the cruise flight phase ATC functions with the AERA plan. The system would also, optimally, interface with aircraft on-board flight management computers to enhance flight efficiency. It is concluded that progress toward automation must be pursued cautiously, and at present ATC functions should continue to be in the control of humans aided by computers. M S K

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

N85-34131# Lincoln Lab, Mass Inst of Tech, Lexington
EFFECT OF INTERFERENCE ON THE PERFORMANCE OF A MINIMUM TCAS 2

R G SANDHOLM 5 Sep 1985 66 p refs
(Contract DOT-FA77WAI-817, F19628-85-C-0002)
(FAA-PM-84-33, ATC-132) Avail NTIS HC A04/MF A01

Minimum TCAS 2 equipment is required to operate reliably in all aircraft densities up to the 0.3 transponder-equipped aircraft per square nautical mile anticipated in the Los Angeles Basin in the year 2000. Prototype TCAS equipment has been developed and shown to be capable of providing reliable surveillance in today's highest densities, which reach an average of about 0.1 aircraft per square nmi. Since there are no existing environments that reach the density of asynchronous interference anticipated for the Los Angeles Basin in the year 2000, it is necessary to generate simulated interference to determine the performance of the TCAS 2 design in that environment. A series of bench tests were conducted for this purpose. Special sources were used to generate asynchronous ATCRBS and Mode S reply signals (fruit) and TACAN DME squitter and interrogation signals. Synchronous ATCRBS and Mode S reply sequences were also generated to simulate airborne encounters. The performance was evaluated by observing how the interference signals either degraded the ability of a TCAS 2 unit to receive, process, and track the desired synchronous reply sequences, or caused the TCAS 2 unit to generate false tracks.

Author

N85-34132# Aeronautical Research Labs, Melbourne (Australia)

GUIDELINES FOR THE EVALUATION OF VISUAL APPROACH SLOPE INDICATORS

J MILLAR Sep 1984 34 p refs
(ARL/SYS-R-32, AR-003-962) Avail NTIS HC A03/MF A01

This report discusses techniques for evaluating the efficacy of Visual Approach Slope Indicators (VASIs) intended for transport aircraft landing at major runways. The discussion is predicated on the assumption that VASI signals should act as a substitute for the information the pilot sees in the natural scene, and a list of design requirements is developed accordingly. Several testing techniques and the utility of information likely to be obtained from each one is outlined. Various aspects of experimental design including the choice of aircraft, pilots, treatments and statistical analysis which can influence the validity of conclusions are highlighted. In many published evaluations to date there has been undue reliance on the subjective opinions of pilots instead of measurements describing flight paths in objective terms. Similarly, operational evaluations have been preferred to more informative experimental tests. Adequate testing of current VASIs could enable substantial improvements to be incorporated into VASI designs of the future, but unfortunately, previous tests have not always been adequate, restricting the pertinence of the findings and limiting the generality of conclusions which might otherwise have influenced subsequent designs.

Author

N85-35179# Mitre Corp, McLean, Va
FAA REQUIREMENTS FOR MODEL TO SUPPORT CAPACITY, DELAY, NOISE AND ENERGY PROGRAMS

J N BARRER and W E WEISS Mar 1985 63 p
(Contract DTFA01-84-C-00001)
(AD-A155815, MTR-WP-85W00174, FAA-DL5-85-1) Avail NTIS HC A04/MF A01 CSCL 17G

This paper was written at the request of the FAA Management Steering Group on System Capacity/Airport Capacity in an effort to answer the recurring question, why should the FAA invest resources in the development and maintenance of models? It summarizes the FAA's requirements for modeling capability to analyze the issues of capacity, delay, noise and fuel burn. It concludes that there is a continuing need for such models and an additional need for airspace model(s) to address these issues in a complex terminal environment. The paper includes a detailed summary of those models related to capacity and delay which are currently owned by the FAA.

GRA

N85-35182# Air Command and Staff Coll, Maxwell AFB, Ala
A GUIDE TO USAF HELICOPTER INSTRUMENT FLIGHT PROCEDURES

L O STENDAHL Apr 1985 36 p
(AD-A156102, ACSC-85-2610) Avail NTIS HC A03/MF A01 CSCL 01B

This report presents information concerning USAF helicopter instrument procedures. This guide consolidates existing and new guidance into an up-to-date, single-source document for use by USAF helicopter pilots. If approved by HQ USAF Instrument Flight Center (IFC), portions of this guide will be incorporated into AFM 51-37. The paper first discusses the need for consolidated guidance, unique helicopter characteristics requiring changes to instrument procedures and how airspace design has been adjusted to accommodate helicopter operations. It then outlines procedures for performing basic helicopter instrument flight, and concludes with a chronological approach to helicopter instrument mission planning and accomplishment. Also included are proposed future changes to helicopter airspace design.

GRA

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology

A85-47256#

REVIEW OF AERONAUTICAL FATIGUE INVESTIGATIONS IN FRANCE DURING THE PERIOD 1983-1985

R LABOURDETTE (ONERA, Chatillon-sous-Bagneux, France)
(International Committee on Aeronautical Fatigue, Symposium, 13th, Pisa, Italy, May 20-24, 1985) ONERA, TP, no 1985-42, 1985, 22 p
(ONERA, TP NO 1985-42)

A brief summary is given of the subject and results of a series of fatigue studies carried out by various aerospace research centers in France during the period 1983-1985. The studies reviewed include the complex fatigue behavior of carbon-epoxy bolted junctions, load monitoring for military aircraft, crack growth lifetime prediction under aeronautical spectrum loading, and analysis and simulation of load spectra for civil aircraft. Other studies discussed include stress intensity factor calculation for built-in or bonded stiffeners, delamination of a composite plate in bending, and flight data acquisition and processing for evaluation of structural fatigue damage.

V L

A85-47302#

UNSTEADY AERODYNAMIC FORCES INDUCED BY AEROELASTIC VIBRATIONS OF A TURBOJET ENGINE IN A NACELLE [FORCES AERODYNAMIQUES INSTATIONNAIRES INDUITES PAR LES VIBRATIONS AEROELASTIQUES D'UN REACTEUR EN NACELLE]

R DESTUYNDER and J J ANGELINI (ONERA, Chatillon-sous-Bagneux, France) (Groupe Sectoriel Franco-Sovietique - Aeronautique, Sous-groupe Aerodynamique, Acoustique Aeronautique et Structures, Reunion, 27th, Chatillon-sous-Bagneux, France, Mar 11-15, 1985) ONERA, TP, no 1985-56, 1985, 22 p. In French
(ONERA, TP NO 1985-56)

The results of theoretical and experimental studies of the effects of a wing-mounted engine nacelle on unsteady aerodynamic forces are reported. Trials were run in a transonic wind tunnel using a rigidly mounted wing with and without the nacelle. The wing-nacelle aerodynamic interactions were not significant but the aerodynamic pitching oscillations of the nacelle alone were sufficient to induce flapping. A cylindrical lifting surface model for the oscillations of the nacelle is defined and shown to have good agreement with experimental data, as well as with predictions made using a method

of doublets. The experimental data are matched if the effects of internal engine rotations are neglected M S K

A85-49007

STRUCTURAL MODE REAL-TIME SIMULATION

K J DYDA and J SEIGEL (Rockwell International Corp., El Segundo, CA) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984 La Jolla, CA, Society for Computer Simulation, 1984, p 50-59

Each of the structural modes in real time flight simulation is characterized by a second-order differential equation which is not only coupled structurally with the other modes, but with the aerodynamic six-degrees-of-freedom equations as well. In order to establish the specific structural modes influencing cockpit motion, a process of elimination has been used. Attention is given to the rigid body modes' force equations, the total vehicle's dynamic equations of motion, symmetric and antisymmetric structural mode equations, and cockpit deflections O C

A85-49008

EVALUATION OF THE AFTI/F-16 ON THE LAMARS (LARGE AMPLITUDE MULTI-MODE AEROSPACE RESEARCH SIMULATOR)

T B R SHINN and F E UNFRIED (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984 La Jolla, CA, Society for Computer Simulation, 1984, p 60-66

An advanced fighter, the AFTI/F-16, is being simulated on the Air Force Flight Dynamics Laboratory's LAMARS to evaluate the control system, pilot/control system interface, and the resulting flying qualities. The AFTI/F-16 LAMARS effort was established to provide the Advanced Development Program Office (ADPO) with a means of investigating important program technical issues in the design of the digital flight control system (DFCS) and the automated maneuvering attack system (AMAS). This paper describes the resources available to the Control Synthesis Branch (FIGD) simulation team, decisions made in implementing the overall simulation program, future simulation requirements, some initial results, and future uses for the simulation. Author

A85-49012

SIMULATION'S ROLE IN THE DEVELOPMENT OF THE FUEL EFFICIENT BOEING 757 AND 767 AIRPLANES

C E PHILLIPS (Boeing Co., Renton Flight Simulation Center, Seattle, WA) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984 La Jolla, CA, Society for Computer Simulation, 1984, p 107-113

Over the course of the 757/767 new generation/high fuel efficiency airliners' development, the Renton Flight Simulation Center (RFSC) engineering simulation facility was used in such vital tasks as the establishment of system specifications, the display and evaluation of aircraft handling characteristics, the design, evaluation, and testing of flight management systems, crew workload studies, and the training of pilots. The RFSC's workload grew from 3600 hours of digital simulation in 1977 to 42,000 hours in 1982, over that 5-year period, \$22 million were expended in the upgrade and expansion of the RFSC's simulation facilities O C

A85-49134#

THE MCA METHOD OF DETERMINING THRUST OF JET AIRCRAFT IN FLIGHT

R E ROSENBERG and G SCHUCH (Bundesamt fuer Wehrtechnik und Beschaffung, Manching, West Germany) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct. 1985, p 888-895. Previously cited in issue 02, p 131, Accession no A84-12337.

A85-49135#

PROJECT ADVANTAGE OF AN OBLIQUE WING DESIGN ON A FLEET AIR DEFENSE MISSION

C D WILER and S N WHITE (Rockwell International Corp., El Segundo, CA) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p 896-900. Previously cited in issue 03, p 10, Accession no A85-13965 refs

A85-49136*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

ARRAYS OF BODIES OF REVOLUTION FOR MINIMUM WAVE DRAG

J N NIELSEN (NASA, Ames Research Center, Moffett Field, CA) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct 1985, p 901-909. Previously cited in issue 07, p 854, Accession no A85-19758 refs

A85-49173

THE EXTENDED RANGE OPERATION OF TWIN-ENGINED PUBLIC TRANSPORT AIRCRAFT. I

V W ATTWOOLL (Civil Aviation Authority, London, England) (Royal Institute of Navigation and Royal Aeronautical Society, Meeting, London, England, Feb 20, 1985) Journal of Navigation (ISSN 0020-3009), vol 38, Sept 1985, p 423-430

Consideration is given to potential operational and economic constraints on the establishment of suitable North Atlantic flight routes for twin-engine 757, 767 and A 310 transport aircraft. The current ICAO regulations only allow four-engined aircraft on the route, the rules having been defined during an era of lower engine reliability. The regulations also specify 60- and 120-min lower and upper limits on flight time to a suitable airport with two engines or one engine out, respectively. The possible implications of adapting the rule to two-engine aircraft are analyzed in terms of the available alternate landing sites along the route, the distances which would have to be traveled at given possible airspeeds, and the associated penalties (if any) for flying sufficiently safe, rather than most economical, routes. The results indicate that enough alternate landing strips are available to permit taking advantage of the flight economies offered by the new wide-body, two-engined aircraft.

M S K

A85-49174

THE EXTENDED RANGE OPERATION OF TWIN-ENGINED PUBLIC TRANSPORT AIRCRAFT. II

A LISTER (Civil Aviation Authority, London, England) (Royal Institute of Navigation and Royal Aeronautical Society, Meeting, London, England, Feb 20, 1985) Journal of Navigation (ISSN 0020-3009), vol 38, Sept 1985, p 431-435

The FAA has, in lieu of a decision by the ICAO, issued an advisory circular listing conditions under which twin-engined transport aircraft such as the A 310, 757 and 767 could operate beyond 60 min flying time from an airport. Reluctance to change the ruling reflects both the previous normal configuration of four engines on transport aircraft and the limited operational experience with large twin-engined aircraft. Certification for operations beyond the 60 min limit will require demonstrable maintenance levels and operational familiarity. All on-board systems must function sufficiently well on one engine, with no intolerable increase in crew workload. Additionally, long-distance flight routes will be allowed only if an adequate number of alternate airports are within reach en route should engine failure occur. The last factor will to a degree be a function of weather forecasts along the planned route M S K

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

A85-49175

THE EXTENDED RANGE OPERATION OF TWIN-ENGINE PUBLIC TRANSPORT AIRCRAFT. III

S GRIEVE (Britannia Airways, Ltd., Luton, England) (Royal Institute of Navigation and Royal Aeronautical Society, Meeting, London, England, Feb 20, 1985) Journal of Navigation (ISSN 0020-3009), vol 38, Sept 1985, p 435-442, Discussion, p 442-444

The UK presently permits twin-engine wide-body passenger aircraft to operate on routes 90 min away from alternate airports with both engines on and 60 min with one engine out. Some concern is expressed that the 90 min distance will be eliminated, thus leaving only the 60 min option for long-distance flights. The shorter interval would cripple commercial operation by UK carriers in some parts of the world. The limiting rule may be further expanded by tripling the required weather factors, i.e., visibility and ceiling, for acceptable alternate airports. It is noted that the operational record with the engines on the A 310, 757 and 767 aircraft belie any concern over the in-flight failure of both engines. Furthermore, the redundancy and reliability of avionics and hydraulics systems are also sufficient to allay the need for stricter regulations. It is concluded that the new twin-engine aircraft are more reliable than the four-engine predecessors. M S K

A85-49199

FOKKER IMPROVES TRANSPORT DESIGN BASED ON LAUNCH CUSTOMER DEMAND

M FEAZEL Aviation Week and Space Technology (ISSN 0005-2175), vol 123, Sept 16, 1985, p 44, 45, 47

The upgraded design of the Fokker 100 is described. It was necessary to improve the aircraft in order to meet the airlines' requirements and to create an aircraft that would grow and be useful into the 21st century. The original design of the aircraft, which was basically a derivative of the F-28, is presented. For the new design the same tooling for the fuselage, wing box, and tail were used, however, a new electrical system and auxiliary power unit were developed. The changes in the aerodynamics of the wing are examined, and the components of the all glass Collins Arnica 700 cockpit avionics suite are explained. The seating capacity was not increased, but the maximum takeoff weight was increased to allow for extended ranges. I F

A85-49200

FIRST OPERATIONAL MARINE CORPS AV-8B SQUADRON BEGINS SERVICE

B M GREELEY, JR Aviation Week and Space Technology (ISSN 0005-2175), vol 123, Sept 16, 1985, p 54, 55, 57, 59, 61

The utilization and evaluation of the AV-8B Harrier 2 by the US Marine Corps are discussed. The effective attack performance, reliability, and maintainability, and the good handling characteristics of the aircraft are verified by the examples of the aircraft's performance during flight training and operation evaluation. The schedule for the incorporation of the AV-8B into the squadrons and the number of pilots and training required is examined. The features of the aircraft which have simplified the V/STOL training process are described. The changes and added components that were incorporated into the aircraft to increase its reliability are explained. The present combat radius of the AV-8B and the addition of night, under-the-weather capability to the system are described. I F

A85-49579

THE EAGLE - A CLASSIC STUDY IN RELIABILITY GROWTH

J J HADEL (McDonnell Aircraft Co., St Louis, MO) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 476-483

The F-15 Eagle development reliability program is reviewed, emphasizing the product production phase of the aircraft, especially with regard to hardware field problems and corresponding solutions. The effects of cumulative changes in the F-15 are often masked by the combining of data from 'new' and 'old' configurations in Air Force reports. Examples of this masking effect are analyzed

to illustrate how misleading the combined data can sometimes be, and the real effects of the changes are examined by segregating the configuration data to reveal the actual extent of reliability growth. Overall reliability growth trends in the Eagle are analyzed which indicate that the reliability of the aircraft has more than tripled in the eight years since initial deployment. The effects of these trends on related parameters such as abort rates and full mission capable rates are shown. C D

A85-49582

F-15 READINESS - THE MAINTAINABILITY CONTRIBUTION

C L KIRKPATRICK and R R OBRIEN (McDonnell Aircraft Co., St Louis, MO) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 499-504

The Full Mission Capable (FMC) rate of aircraft maintainability of the F-15 combat aircraft is estimated and compared to classic maintainability indicators. The results are used to predict factors influencing F-15 availability during peacetime and during wartime. Squadron sorties rates of 3.4-4.8 sorties per day per aircraft are predicted based on the Air Force Logistics composite model and historical maintenance rates and repair times. Among the factors influencing the availability of F-15 aircraft during wartime are the availability of unencumbered dispersed servicing areas, the use of built-in test equipment, and a hot refuel capability with one or two engines running. Maintainability improvements planned for future F-15 designs are briefly reviewed. I H

A85-49656

STAR IN THE MAKING

H HOPKINS Flight International (ISSN 0015-3710), vol 128, Sept 7, 1985, p 23-28

Astra, which has been built by an Israeli aircraft manufacturer, is the revolutionary product of an evolutionary line of business jets. The aircraft employs an Israeli-developed swept, supercritical wing. Aims of the design of Astra are related to a high-Mach-number cruise (around 0.8), reasonable fuel economy, good long-range performance (at about Mach 0.7), and a high ratio of payload to aircraft weight. Three Astra prototypes have been used in the flight-test program. One aircraft has demonstrated the type's ability to fly coast-to-coast across the United States at Mach 0.8. Observations made during a flight of Astra are discussed, taking into account the start-up, the takeoff, well-balanced handling, cabin considerations, the exemplary stall behavior, and some operational details. G R

A85-49658

GIV - GULFSTREAM GOES FURTHER

G WARWICK Flight International (ISSN 0015-3710), vol 128, Sept 14, 1985, p 28-36

A new model of the Gulfstream aircraft (G), GIV, is described in detail. The redesigned frame features and the changes in the aircraft systems, engine, and materials, made in the present GIII model, which extend the flight range of GIV to 4300 n.m. at Mach 0.8, and altitudes to 45,000 ft, and make it more fuel-efficient, are specified. Among the newly added systems, the factory-fitted integrated digital avionics is the most significant. The system includes an automatic flight control system (autopilot and autothrottle), flight management (navigation and performance), electronic displays, including engine instrumentation and crew altering, and sensor integration, all with the dual redundancy as a minimum. The key element in the system is the avionics standard communication bus (ASCB), which transmits and receives information among the subsystems via a two-wire data highway. I S

A85-49672

ANALYSIS OF ASYMMETRIC NATURAL VIBRATIONS OF AN AEROPLANE WITH MOVING DEFORMABLE CONTROL SURFACES

Z DZYGADLO and J BLASZCZYK Journal of Technical Physics (ISSN 0324-8313), vol 25, no 3-4, 1984, p 393-412 refs

The results of theoretical and numerical studies of natural vibrations of an aircraft with deformable control surfaces are discussed. The deformable assemblies of the aircraft are discretized by introducing beam elements and using the finite element method. The present model is composed of rigid assemblies and deformable assemblies with continuous and jump-like distribution of mass and rigidity. Equations of motion are established for the rigidity. Equations of motion are established for the rigid parts of the fuselage and equations of dynamic equilibrium for the deformable assemblies of the aircraft. A set of equations is obtained whose solution gives the required spectrum of asymmetric vibrations of an aircraft with moving deformable control surfaces. C D

A85-49673

ANALYSIS OF NATURAL VIBRATIONS OF A DEFORMABLE AEROPLANE WITH FIXED CONTROL SYSTEMS

Z DZYGADLO, I NOWOTARSKI, and A OLEJNIK Journal of Technical Physics (ISSN 0324-8313), vol 25, no 3-4, 1984, p 413-421 refs

A numerical analysis of the natural frequencies and modes of a deformable aircraft with fixed control surfaces is presented. Results have been obtained for both a fictitious and a real aircraft. The differences between the frequencies and modes of the aircraft having supports of varying rigidities are used to infer that the influence of an elastic support on the natural vibrations can be disregarded if the ratio of the frequency of the support to the lowest natural frequency of the deformable aircraft is small. The model presented here allows the natural frequencies of an aircraft of any geometrical and mass configuration to be studied in an effective way. C D

A85-49912

JVX DESIGN TO COST METHODOLOGY

S Y HOWELL (Bell Helicopter Textron, Fort Worth, TX) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 24 p refs (SAWE PAPER 1591)

The preliminary design and full scale development phase team that will undertake the design-to-cost (DTC) program for the Joint Services Advanced Vertical Lift Aircraft, designed 'JVX', encompasses employees from such disciplines as engineering cost analysis, finance, industrial engineering, manufacturing engineering, producibility engineering and planning, and procurement. The DTC team uses parametric techniques to predict costs during preliminary design, subsequently, as more detailed information becomes available, the DTC team resorts to 'grass roots' estimating techniques for cost estimation, on the basis of design layouts and detailed design drawings. O C

A85-49915

IN-PRODUCTION AIRCRAFT WEIGHT CONTROL

A D G BAYLY (Lockheed-California Co, Burbank) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 16 p (SAWE PAPER 1597)

A development history is presented for weight control efforts directed to successive variants of the maritime patrol/ASW Orion P3 aircraft, which first entered service in 1961. Weight control measures have at various times been prompted by the incorporation of more powerful engines, additional signal analysis equipment, navigation aids, and electronic countermeasures, and rearrangements of internal equipment and stores. Attention is given to major redesign efforts undertaken to reduce weight, and the effect of these efforts on center-of-gravity location. O C

A85-49920

AN EVALUATION OF IMPROVED ANALYTICALLY BASED WEIGHT ESTIMATION METHODOLOGIES

M K MYERS (LTV Aerospace and Defense Co, Vaught Aero Products Div, Dallas, TX) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 12 p (SAWE PAPER 1616)

A new geometry characterization routine (GCR) was found to be mandatory for updating the existing synthesis programs for modeling changing aircraft configurations in the future. The GCR is primarily a new manner of feeding the configurational data into the Aircraft Synthesis Analysis program (ASAP). It will need a CADAM interface, and routines requiring the spatial coordinates of the aircraft's external and internal envelopes. The interfaces for radar and IR cross-sectional configurations will be useful but are not mandatory. The additional structural mandatory concepts are the blended bodies and buried engines, methods for weight estimates of individual fuselage portions, and alternate wing construction techniques. A new catalogue technique, illustrated with a diagram, will increase the productivity of ASAP. Also discussed are new methods for estimating composite construction, a new approach to structural analysis, and crack growth criteria. I S

A85-49921

AFTI MAW - WING OF THE FUTURE

R W RANKIN (Boeing Military Airplane Co, Wichita, KS) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 24 p (SAWE PAPER 1617)

The Mission Adaptive Wing (MAW) concept, which is undergoing evaluation in the Advanced Fighter Technology Integrator (AFTI) F-111, draws on recent advancements in materials, actuators and electronic flight control systems to change airfoil profiles in flight, and thereby conform to the diverse requirements of maneuvering, cruise, and low level penetration segments of a mission at either subsonic or supersonic speeds. Variable camber through smooth deformation of leading and trailing edges is achieved by internal actuation/deformation mechanisms and thin wing skin panels. The AFTI F-111 is an ideal test bed in that it is a variable wing sweep aircraft capable of testing variable camber over a wider range of wing geometry conditions. O C

A85-49925

A GLANCE AT SOVIET HELICOPTER WEIGHT TRENDS AND A WEIGHT-PREDICTION METHOD

R A SHINN (U S Army, Aviation Systems Command, St Louis, MO) and W Z STEPNIIEWSKI (International Technical Associates, Ltd, Upper Darby, PA) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 21 p refs (SAWE PAPER 1627)

The designs of Western and Soviet helicopters in the 5,000-150,000 lb gross-weight range were compared with respect to relative weight empty, zero-range payload, and engine specific weight, as well as relative weights of major helicopter components. The traditional (until the early seventies) Mil and Kamov Soviet helicopters are inferior in their operational productivity to their Western counterparts, mainly because of the weight gap in the airframes and powerplants. However, the operational new-generation and 'hypothetical' helicopters have the weight-empty, and zero-range payload to gross weight ratios similar to those of the Western counterparts. The general approach of a Soviet weight prediction method for major helicopter components, illustrated by weight equations and graphs, is compared to the Western methods, and the use of these methods in structural weight minimization is examined. Aspects of widening the productivity gap between the Soviet and the Western rotary aircraft are discussed. I S

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

A85-49926

COMPUTER AIDED DETERMINATION OF ROTOR BLADE MASS PROPERTIES

R HUFF (Hughes Helicopters, Inc., Culver City, CA) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 39 p (SAWE PAPER 1628)

The present, computer program-implemented method for rotor blade design mass properties analysis allows calculation of individual component characteristics, each structural lamina or geometrical configuration entered is processed by an appropriate subroutine. The results thus obtained are added to totals for subgroup, main group, and case levels. Attention is given to a general procedure for the definition of blade contours at critical points, the classification of blade parts into different categories for analysis, and the properties of spanwise segments selected by the user for calculation and presentation in printouts. O C

A85-49944

THE USAF'S CREST PROGRAM

A M HIGGINS and E O ROBERTS (USAF, Aerospace Medical Div., Wright-Patterson AFB, OH) SAFE Journal, vol 15, Fall 1985, p 10-16 refs

The USAF recently initiated a five-year advanced development (6.3) effort in ejection seat design called CREW EScAPE Technologies or CREST. The objective of the CREST program is to develop and demonstrate, through full-scale testing, new escape system technologies required to reduce fatalities and major injuries in future aircraft ejections. The CREST design philosophy is based on the concept of adaptive control of the escape system and successful demonstration of the CREST technologies will lay the foundation for the development of the next-generation ejection seat. This paper describes the program's content and schedule with particular emphasis on the current Phase I activities of the CREST contracted effort. In addition, several efforts supporting the CREST program are also discussed. Author

A85-49945

ADAPTIVE OPERATION OF ESCAPE SYSTEMS - A LOOK AT DESIGN REQUIREMENTS

R J DOBBEK (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) SAFE Journal, vol 15, Fall 1985, p 22-26 refs

Some design requirements for an escape system which incorporates the adaptive operation technique are presented. This newly designed escape system would generate controlled adaptive performance. The major external parameters that affect the performance of the ejection catapult and must be considered in the design are (1) variation in ejected mass, (2) variation in propellant temperature, and (3) variation in the surrounding acceleration field acting against the catapult. The design considerations for flight dynamics, which include controlling catapult acceleration and attitude control of the occupied ejection seats, are described. The use of trajectory control to clear the aircraft, to provide a divergent trajectory from other ejectees and equipment, and to prevent premature ground impact is discussed. The development of a recovery system, which is adaptive to changing conditions, is explained. I F

A85-49946

GENERALIZED ESCAPE SYSTEM SIMULATION - ITS PURPOSE, RECENT MODIFICATIONS, AND POTENTIAL

G E LIEPINS and S Y OHR (Oak Ridge National Laboratory, TN) SAFE Journal, vol 15, Fall 1985, p 27-31 Navy-sponsored research

(Contract DE-AC05-84OR-21400)

The Generalized Escape System Simulation (GESS) code, which is capable of simulating a number of ejection system hardware performances, is discussed. The code is written in FORTRAN, is compatible with most mainframe computers, and contains a number of subroutines. The GESS program can calculate the trajectory for up to four escape system components, examples of how the GESS code models various ejection phenomena are provided. Comparisons of sled test results and analytically computed results

with GESS results are graphically presented, GESS results correlated well with escape system test data. Further research is being conducted in order to make the GESS an integral part of an in-service usage data analysis system. A comprehensive flow chart is provided. I F

A85-50101* National Aeronautics and Space Administration Langley Research Center, Hampton, Va CRASHWORTHY DESIGN CONSIDERATIONS FOR GENERAL AVIATION SEATS

E ALFARO-BOU, E L FASANELLA, and M S WILLIAMS (NASA, Langley Research Center, Hampton, VA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 16 p refs (SAE PAPER 850855)

This report summarizes the experimental research conducted at the NASA Langley Research Center on general aviation seat and occupant crash response and discusses seat design considerations. Included are typical floor acceleration pulses from general aviation airplane crash tests, the performance of typical general aviation seats in a simulated crash environment, and the performance of prototype energy absorbing (EA) seat designs. Static and dynamic seat testing procedures and test facilities are discussed. Also presented are results from a series of dynamic tests of typical general aviation seats and prototype EA seats. Author

A85-50102*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va FLIGHT EVALUATION OF AN INSECT CONTAMINATION PROTECTION SYSTEM FOR LAMINAR FLOW WINGS

C C CROOM and B J HOLMES (NASA, Langley Research Center, Hampton, VA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 10 p refs (SAE PAPER 850860)

The maintenance of minimum wing leading edge contamination is critical to the preservation of drag-reducing laminar flow, previous methods for the prevention of leading edge contamination by insects have, however, been rendered impractical by their excessive weight, cost, or inconvenience. Attention is presently given to the results of a NASA flight experiment which evaluated the performance of a porous leading edge fluid-discharge ice protection system in the novel role of insect contamination removal, high insect contamination conditions were also noted in the experiment. Very small amounts of the fluid are found to be sufficient for insect contamination protection. O C

A85-50103*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va MANUFACTURING TOLERANCES FOR NATURAL LAMINAR FLOW AIRFRAME SURFACES

B J HOLMES (NASA, Langley Research Center, Hampton, VA), C J OBARA, G L MARTIN, and C S DOMACK (Kentron International, Inc., Hampton, VA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 11 p refs (SAE PAPER 850863)

Published aircraft surface waviness and boundary layer transition measurements imply that currently achievable low levels of surface waviness are compatible with the natural laminar flow (NLF) requirements of business and commuter aircraft, in the cases of both metallic and composite material airframes. The primary challenge to the manufacture of NLF-compatible surfaces is two-dimensional roughness in the form of steps and gaps at structural joints. Attention is presently given to recent NASA investigations of manufacturing tolerance requirements for NLF surfaces, including flight experiment results. O C

A85-50107

PROPULSIVE EFFICIENCY AND AIRCRAFT DRAG DETERMINED FROM STEADY STATE FLIGHT TEST DATA

G BULL and G BENNETT (Mississippi State University, MS) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 15 p
(SAE PAPER 850872)

Propulsive efficiency and aircraft drag are presently derived from steady, level flight speed-power data by a method that is based on a computer formulation of Lock's (1935) equivalent propeller model, this makes the method suitable for use in parameter identification. The results obtained take the form of coefficients of polynomials that define the aircraft and propeller. The method is especially applicable to performance prediction and simulation, because aircraft and propeller are represented by a simple analytical model rather than tables and graphs O C

A85-50109* Bolt, Beranek, and Newman, Inc., Canoga Park, Calif

FLIGHT INVESTIGATION OF CABIN NOISE CONTROL TREATMENTS FOR A LIGHT TURBOPROP AIRCRAFT

J F WILBY (Bolt Beranek and Newman, Inc., Canoga Park, CA), R L ONEAL (Gulfstream Aerospace Corp., Bethany, OK), and J S MIXSON (NASA, Langley Research Center, Hampton, VA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 16 p NASA-supported research refs
(SAE PAPER 850876)

The in-flight evaluation of noise control treatments for a light, twin-engined turboprop aircraft presents several problems associated with data analysis and interpretation. These problems include data repeatability, propeller synchronization, spatial distributions of the exterior pressure field and acoustic treatment, and the presence of flanking paths. They are discussed here with regard to a specific aeroplane configuration. Measurements were made in an untreated cabin and in a cabin fitted with an experimental sidewall treatment. Results are presented in terms of the insertion loss provided by the treatment and comparison made with predictions based on laboratory measurements

Author

A85-50111* Virginia Polytechnic Inst. and State Univ., Blacksburg

MECHANISMS OF TRANSMISSION AND CONTROL OF LOW-FREQUENCY SOUND IN AIRCRAFT INTERIORS

C R FULLER (Virginia Polytechnic Institute and State University, Blacksburg, VA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr. 16-19, 1985 14 p refs
(Contract NAG1-390)
(SAE PAPER 850879)

A simplified analytical model is used to study the principal mechanisms at work in propeller noise source radiation, fuselage response, and the behavior of the coupled inner acoustic field, in order to control low frequency sound in aircraft interiors. Both active and passive methods of noise control are comparatively evaluated in light of the transmission mechanisms. Fuselage vibrational response is noted to be dominated by only a few lower order circumferential modes. O C

A85-50117

ADVANCED SYSTEMS FOR THE GULFSTREAM IV

R WINTERS (Gulfstream Aerospace Corp., Savannah, GA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 6 p
(SAE PAPER 850900)

The Gulfstream IV corporate jet aircraft incorporates among its advanced systems solid state electric power generation, digital electronics, and an integrated avionics/subsystems electronic control design. In order to undertake missions with maximum cost effectiveness, least time, or combinations of these two criteria, flight can be automated throughout the takeoff, climb, cruise, descent, and landing regimes, under almost all weather conditions. Attention is given to the cockpit display system, flight management and guidance systems, engine instrument and crew alert systems,

steering and braking control, and electrical power generation

O C

A85-50118

AIR-CYCLE AIR CONDITIONING OF TURBINE-POWERED GENERAL AVIATION AND COMMUTER AIRCRAFT

G K PAYNE (AirResearch Manufacturing Co., Torrance, CA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 15 p
(SAE PAPER 850901)

The use of an air cycle system which operates in conjunction with general aviation and commuter aircraft turbine powerplants facilitates the design of systems that can furnish cabin heating, cooling, pressurization, humidity control and temperature control without recourse to an independent power source. Attention is presently given to air cycle system configurations and constituent features, system installation, performance data, and equipment selection guidelines are illustrated O C

A85-50126

USAF DAMAGE TOLERANCE METHODS APPLIED TO GENERAL AVIATION AIRCRAFT DESIGN AND ANALYSIS

W A BARNROVER (USAF, Logistics Command, Tinker AFB, OK) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 10 p refs
(SAE PAPER 850915)

Attention is given to potential benefits to be derived from U.S. Air Force expertise and experience in the design and management of damage-tolerant structures, as found in the military standard MIL-STD-1530. The primary factor in the reduction of structural failures to date has been the awareness instilled in personnel of fatigue processes and their symptoms. Aircraft structural integrity program tasks encompass the use of design information, the use of design analyses and development tests, full scale testing, and the compilation of fleet management data O C

A85-50127

THE STRUCTURAL DYNAMICS OF ELECTRO-IMPULSE DE-ICING ON THE LEAR FAN KEVLAR COMPOSITE LEADING EDGE

T PARAMASIVAM and G W ZUMWALT (Wichita State University, KS) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 15 p refs
(SAE PAPER 850917)

Attention is given to results obtained to date in analytical studies and laboratory tests of the electro-impulse deicing method, designated 'EIDI', as applied to a Kevlar-reinforced composite wing leading edge under the direction of NASA-Lewis. EIDI uses copper coils inside the leading edge to discharge capacitors and thereby create a rapidly rising and falling electromagnetic field. The repulsive force generated in a fraction of a millisecond within the leading edge skin serves to debond and expel attached ice O C

A85-50129

FLIGHT TESTING A LIQUID ICE PROTECTION SYSTEM ON A SINGLE-ENGINE AIRPLANE

R L NEWMAN (Crew Systems Consultants, Yellow Springs, OH) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 10 p refs
(SAE PAPER 850923)

The installation and testing of a freezing point fluid depressant ice protection system on a single-engine Cessna 206 is discussed. The system sprays an ethylene glycol solution over the leading edge of the wings, empennage, and lift struts. A slinger ring distributes fluid to the propeller and a glycol spraybar deices the windshield. Aft cg stability tests and forward cg control tests were performed to evaluate the handling qualities of the modified aircraft. The system's installation had no effect on the performance of the aircraft. The technique used to estimate droplet diameter is explained. Samples of some flight testing situations are presented. The results revealed the ice protection system is capable of preventing ice accumulation I F

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

A85-50130

SPORT AIRCRAFT DESIGN TRENDS - SHAPING THE FUTURE OF GENERAL AVIATION

S K WOOD SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 11 p refs (SAE PAPER 850881)

The rapidity with which sport aircraft designers can develop and test novel configuration concepts inexpensively has drawn attention to their efforts as a major source of technological innovation. A historical account is presently given for noteworthy sport aircraft development contributions to aeronautical progress, and such recent, highly innovative designs as the Rutan (1975) Var-Eze are assessed as sources of enhanced efficiency general aviation aircraft configurations. Future projections are made on the basis of recent design trends. O C

A85-50131

CONTOUR ASSESSMENT OF FORMED WING PANELS

H R COOK (AVCO Corp., Avco Aerostructure Div., Nashville, TN) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 8 p (SAE PAPER 850884)

A procedure which utilizes finite element analysis in the contour assessment of formed wing panels is described. This procedure was designed to test age-formed integrally stiffened aluminum alloy panels with skin thickness ranging from 0.50 to 2.00 inches. The first step in the procedure involves the creation of a finite element model, which reflects the bidirectional stiffness of the panel in conjunction with local deviations from contour, using the MSC/NASTRAN computer program. Then finite element analysis, using converted inspection data, is performed to determine the forces required to close the local gaps to within specified shimming allowances. These results are compared to allowable fit-up forces and from this comparison contour adjustment can be determined. An example of the implementation of this procedure on an integrally stiffened panel segment is given. I F

N85-34135*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

FLIGHT TESTING THE FIXED-WING CONFIGURATION OF THE ROTOR SYSTEMS RESEARCH AIRCRAFT (RSRA)

G W HALL and P M MORRIS (Army Aeromechanics Lab.) St Louis, Mo Army Aviation Systems Command Jun 1985 17 p (NASA-TM-86762, REPT-85283, NAS 1 15 86762, USAVSCOM-TM-85-A-4) Avail NTIS HC A02/MF A01 CSCL 01C

The Rotor Systems Research Aircraft (RSRA) is a unique research aircraft designed to flight test advanced helicopter rotor system. Its principal flight test configuration is as a compound helicopter. The fixed wing configuration of the RSRA was primarily considered an energy fly-home mode in the event it became necessary to sever an unstable rotor system in flight. While it had always been planned to flight test the fixed wing configuration, the selection of the RSRA as the flight test bed for the X-wing rotor accelerated this schedule. This paper discusses the build-up to, and the test of, the RSRA fixed wing configuration. It is written primarily from the test pilot's perspective. Author

N85-34136*# Hydraulic Research Textron, Irvine, Calif Systems Engineering Div

INTELLIGENT REDUNDANT ACTUATION SYSTEM REQUIREMENTS AND PRELIMINARY SYSTEM DESIGN

P DEFEQ, L J GEIGER, and J HARRIS Sep 1985 80 p (Contract NAS2-12081)

(NASA-CR-177366, NAS 1 26 177366, HR-73600253) Avail NTIS HC A05/MF A01 CSCL 01C

Several redundant actuation system configurations were designed and demonstrated to satisfy the stringent operational requirements of advanced flight control systems. However, this has been accomplished largely through brute force hardware redundancy, resulting in significantly increased computational requirements on the flight control computers which perform the failure analysis and reconfiguration management. Modern

technology now provides powerful, low-cost microprocessors which are effective in performing failure isolation and configuration management at the local actuator level. One such concept, called an Intelligent Redundant Actuation System (IRAS), significantly reduces the flight control computer requirements and performs the local tasks more comprehensively than previously feasible. The requirements and preliminary design of an experimental laboratory system capable of demonstrating the concept and sufficiently flexible to explore a variety of configurations are discussed. R J F

N85-35183 North Carolina State Univ., Raleigh

AN AUTOMATED TECHNIQUE FOR ENCASEING SPECIFIC PAYLOADS WITH LOW-DRAG FAIRINGS Ph.D. Thesis

S R FOX 1984 492 p

Avail Univ Microfilms Order No DA8507365

The energy crisis and the recent advances in technology have provided the incentive to develop an automated analytical technique that will design low-speed, low-drag vehicles which encase specific payloads. The present work represents an effort to develop such a technique by the coupling of a flow analysis method, an optimization method, a shape perturbation scheme, and a three-dimensional plotting routine. This technique, which is applicable or easily adaptable to both aerodynamic and submerged hydrodynamic vehicle designs, orchestrates shape modifications to an arbitrary circumscribing body within the constraints stipulated by the specific payload. The evidence to date indicates that with astute modeling the present technique can produce low-drag, cost-effective designs. Dissert Abstr

N85-35184*# Simula, Inc., Phoenix, Ariz

DESIGN AND TESTING OF AN ENERGY-ABSORBING CREWSEAT FOR THE F/FB-111 AIRCRAFT. VOLUME 2: DATA FROM SEAT TESTING Final Report, May 1983 - May 1985

S J SHANE Washington NASA Sep 1985 337 p 3 Vol

(Contract NAS1-17387)

(NASA-CR-3917, NAS 1 26 3917, TR-84428-VOL-2) Avail NTIS HC A15/MF A01 CSCL 01C

The unacceptably high injury rate during the escape sequence (including the ejection and ground impact) of the crew module for F/FB-111 aircraft is reviewed. A program to determine if the injury potential could be reduced by replacing the existing crewseats with energy absorbing crewseats is presented. An energy absorbing test seat is designed using much of the existing seat hardware. An extensive dynamic seat test series, designed to duplicate various crew module ground impact conditions is conducted at a sled test facility. Comparative tests with operational F-111 crewseats are also conducted. After successful dynamic testing of the seat, more testing is conducted with the seats mounted in an F-111 crew module. Both swing tests and vertical drop tests are conducted. The vertical drop tests are used to obtain comparative data between the energy absorbing and operational seats. Volume 1 describes the energy absorbing test seat and testing conducted, and evaluates the data from both test series. Volume 2 presents the data obtained during the seat test series, while Volume 3 presents the data from the crew module test series. Author

N85-35185*# SKF Industries, Inc., King of Prussia, Pa

PLANETARY-GEAR-SUPPORT BEARING TEST RIG DESIGN Contractor Report, 8 Feb. 1983 - 8 Jan. 1985

J W ROSENLEIB Mar 1985 81 p

(Contract NAS3-23702)

(NASA-CR-174927, NAS 1 26 174927, AT85T004) Avail NTIS HC A05/MF A01 CSCL 01C

A test rig was designed to evaluate the performance of a spherical roller bearing with a geared outer ring operating under conditions similar to those of a planet bearing in a helicopter transmission. The configuration is an extension of the widely accepted four-square gearbox arrangement. It provides for testing of two bearings simultaneously with outer ring rotation, misalignment, diametrically opposed loading through the gear teeth, and under race lubrication. Instrumentation permits the measurement of inner and outer ring temperature, bearing drag

torque, degree of misalignment, outer ring speed, cage speed, and applied load
Author

N85-35186*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept of Aerospace and Ocean Engineering
ENERGY MANAGEMENT OF THREE-DIMENSIONAL MINIMUM-TIME INTERCEPT Interim Report
H G VISSER, H J KELLEY, and E M CLIFF Jul 1983 121 p refs
(Contract NAG1-203)
(NASA-CR-176174, NAS 1 26 176174) Avail NTIS HC A06/MF A01 CSCL 01C

A real-time computer algorithm to control and optimize aircraft flight profiles is described and applied to a three-dimensional minimum-time intercept mission
Author

N85-35187# Aeronautical Research Labs, Melbourne (Australia).
FATIGUE LIVES OF SPECIMENS REPRESENTING CRITICAL LOCATIONS IN MIRAGE 3 SPARS UNDER AUSTRALIAN AND SWISS TEST SPECTRA

J Y MANN and G W REVILL 1985 68 p refs
(ARL-STRUC-R-415, AR-003-998) Avail NTIS HC A04/MF A01
Full scale flight by flight fatigue tests on Mirage 3 fighter aircraft wings carried out at the Australian Aeronautical Research Laboratories (ARL) and the Swiss Eidgenossisches Flugzeugwerk (F+W) indicated much greater differences in the flights to failure than were expected. This problem has been investigated by conducting fatigue tests on specimens representing the major failure locations in the test wings - a blind anchor nut hole in the Australian case and an interference fit bolt hole in the Swiss case - under flight by flight loading sequences corresponding to those used in the full scale tests. Constant amplitude fatigue tests were also carried out on the blind hole specimens to provide information for life estimation purposes, and fractographic crack propagation studies were conducted on selected blind hole specimens. The experimentally determined lives of both types of specimen were greater under the Australian than the Swiss stress spectrum. Depending on the stress scaling factor considered the life ratio (Australian/Swiss flights) obtained by grouping together the two stress spectra and the two types of specimens were between 3 and 4.2. For the blind anchor nut hole specimens the predicted fatigue lives were less than those obtained experimentally at high stress scaling factors, but at low stress scaling factors the converse was the case
Author

N85-35188# Army Test and Evaluation Command, Aberdeen Proving Ground, Md
LABORATORY VIBRATION SCHEDULES Final Report
11 Mar 1985 243 p Supersedes TOP-1-2-601
(AD-A155856, ITOP-1-2-601, TOP-1-2-601-REV) Avail NTIS HC A11/MF A01 CSCL 14B

This ITOP describes two types of vibration tests conducted in the laboratory first, a mission/field secured cargo test to simulate the transportation of Army material as secured cargo during logistical shipments, and second, an application-induced vibration test to simulate the tactical vibration environment experienced by equipment installed in/on ground vehicles or helicopters. No attempt is made to address the vibration environments for equipment installed in fixed-wing aircraft, missiles, and ships (marine equipment)
GRA

N85-35189# Naval Postgraduate School, Monterey, Calif
THE EFFECTS OF PARAMETER VARIATION ON HELICOPTER PERFORMANCE M.S. Thesis
C K KIM Mar 1985 65 p
(AD-A156027, AD-E900451) Avail NTIS HC A04/MF A01 CSCL 21G

Six different cases of helicopter main rotor parameter variation are considered for each of three different forward velocities - hover, sixty knots and one-hundred fifty knots in order to consider the effects of the changes on the total power required for the helicopter. The six cases included variations in rotor radius, rotor chord, solidity

disc area, rotational velocity and tip velocity. Although strong positive or negative effects may be observed at some velocities, these trends are generally not the same at all velocities, indicating that trade-offs must be made in the design process in order to optimize the level flight performance
GRA

N85-35190# Naval Postgraduate School, Monterey, Calif.
DEVELOPMENT OF NATOPS (NAVAL AIR TRAINING AND OPERATING PROCEDURE STANDARDIZATION) PERFORMANCE SOFTWARE FOR THE H-46D HELICOPTER M.S. Thesis

J M CARAM Mar 1985 74 p
(AD-A156089) Avail NTIS HC A04/MF A01 CSCL 09B

This thesis generates closed-form equations for significant and frequently used Naval Air Training and Operating Procedure Standardization (NATOPS) performance charts for the H-46D and H-46A (with T58-GE-10 engines) helicopters. These equations are developed into interactive software for the Hewlett-Packard HP-41CV hand-held programmable calculator. With this software installed in the calculator the user is able to calculate numerous NATOPS performance parameters (expeditiously, with reduced risk of error) both prior to and in flight
Author (GRA)

N85-35191# Air Command and Staff Coll, Maxwell AFB, Ala
RAFTS: A T-38 REPLACEMENT FOR THE 21ST CENTURY
R C CHAPMAN, JR Apr 1985 35 p
(AD-A156103, ACSC-85-0435) Avail NTIS HC A03/MF A01 CSCL 01C

The Reconnaissance Attack Fighter Training System (RAFTS) is designed to bridge the performance and systems gap between the T-46A and the Advanced Tactical Fighter (ATF). This training system will replace the T-38 now used in undergraduate pilot training. The study addresses the probable training environment, technology, training requirements, syllabi, and embedded training systems in the late 1990's. The study concludes with a conceptual design of the T-38 aircraft replacement for the 21st century
Author (GRA)

N85-35192# Naval Postgraduate School, Monterey, Calif
DEVELOPMENT OF NATOPS PERFORMANCE SOFTWARE FOR THE SH-3D AND SH-3H HELICOPTERS M.S. Thesis

J T CURTIS Mar 1985 107 p
(AD-A156140) Avail NTIS HC A06/MF A01 CSCL 01B

This thesis generates closed form equations for significant and frequently used Naval Air Training and Operating Procedure Standardization (NATOPS) performance charts for the SH-3D and SH-3H helicopters. These equations are developed into interactive software for the Hewlett-Packard HP-41CV hand-held programmable calculator. With this software installed in the calculator the user is able to calculate numerous NATOPS performance parameters (expeditiously, with reduced risk of error) both prior to and in flight
Author (GRA)

N85-35193# Air Command and Staff Coll, Maxwell AFB, Ala
NEXT GENERATION GUNSHIP
W F HOLLOWAY Apr 1985 39 p
(AD-A156361, AD-E900463, ACSC-85-1235) Avail NTIS HC A03/MF A01 CSCL 01C

Special Operations Forces (SOF) possess requirements for unique air-to-ground attack and reconnaissance capabilities. Conventional air assets do not possess these capabilities. The present SOF air-to-ground attack weapon system, the AC-130 gunship, suffers from inherent tactical and system limitations. The study explores the requirements, the tactical employment concepts, and design considerations for a new gunship. The study concludes that a new gunship must not be a modified conventional airplane, but a dedicated weapon system designed and built for SOF
Author (GRA)

N85-35544# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Inst fuer Physik der Atmosphaere
TYPICAL AND HISTORICAL ASPECTS OF MOTOR GLIDERS AS METEOROLOGICAL MEASURING AIRCRAFT [TYPISCHES UND GESCHICHTLICHES ZUM MOTORSEGLER ALS METEOROLOGISCHES MESSFLUGZEUG]
 M E REINHARDT *In its* Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 15-28 Jan 1985 refs In GERMAN
 Avail NTIS HC A10/MF A01

The history of motor gliders used for meteorological flight since 1920 is depicted Motor glider is defined Historical requirements for gliding aircraft with built-in motor are mentioned The characteristics of motor gliders, their wing loading, and motor power are shown The milestones marked by these motor gliders are explained The expectations for meteorological measurements with motor gliders are outlined Author (ESA)

06

AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices, and flight instruments

A85-47699
A LIKELIHOOD FUNCTION METHOD FOR MULTIPLE AIRCRAFT MANEUVER TRACKING
 A W WARREN (Boeing Computer Services Co., Tukwila, WA) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 415-422 refs

An algorithm for correlating and tracking high G acceleration targets in a multiple target environment is presented The maneuver adaptation algorithm is based on hypothesis testing correlation logic and the likelihood function method The surveillance system environment used to test the proposed tracking method is described The hypotheses and logic for the maneuver tracking are given The equations necessary for minimizing the likelihood distance function and the modified Gauss-Newton iterative method necessary for establishing the parameters are presented The procedure for validating or rejecting the maneuver adaptation method is demonstrated The application of the maneuver adaptation method to a multitarget tracking simulation is discussed I F

A85-47757* Carnegie-Mellon Univ., Pittsburgh, Pa
VALIDATION OF FAULT-FREE BEHAVIOR OF A RELIABLE MULTIPROCESSOR SYSTEM - FTMP: A CASE STUDY
 E CLUNE, Z SEGALL, and D SIEWIOREK (Carnegie-Mellon University, Pittsburgh, PA) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 2 New York, IEEE, 1984, p 1112-1120 refs
 (Contract NAG1-190)

A program of experiments has been conducted at NASA-Langley to test the fault-free performance of a Fault-Tolerant Multiprocessor (FTMP) avionics system for next-generation aircraft Baseline measurements of an operating FTMP system were obtained with respect to the following parameters instruction execution time, frame size, and the variation of clock ticks The mechanisms of frame stretching were also investigated The experimental results are summarized in a table Areas of interest for future tests are identified, with emphasis given to the implementation of a synthetic workload generation mechanism on FTMP I H

A85-47760
A FAULT AND DAMAGE TOLERANT NETWORK FOR AN ADVANCED TRANSPORT AIRCRAFT
 J H LALA, A RAY, R HARPER (Charles Stark Draper Laboratory, Inc., Cambridge, MA), and D B MULCARE (Lockheed-Georgia Co., Marietta, GA) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings. Volume 2 New York, IEEE, 1984, p 1138-1142 refs

The concept of a fault and damage tolerant communications network has been proposed previously for applications requiring high reliability This concept is now being considered for an Advanced Transport Aircraft to connect sensors, actuators and subsystems to a central computer instead of redundant multiplexed data buses In this paper, the reliability of such a network has been evaluated for a baseline configuration in which all sensors, actuators and communications subsystems are quadruply redundant The processing overhead associated with managing the network redundancy, uncovering and identifying faults in the nodes and links of the network, and repairing the network in the presence of faults and damage are also estimated These estimates are derived from execution times of actual algorithms running on a quad redundant computer that interfaces with the simulated network Author

A85-47791
THE DESIGN OF A FLUIDIC LOW-AIRSPEED SENSOR
 G MON (U S Army, Harry Diamond Laboratories, Adelphi, MD) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 3 New York, IEEE, 1984, p 1708-1713 Navy-supported research refs

A low-air-speed sensor (LASS) for military aircraft has been designed and tested The design of this sensor is based on the interaction of the airstream and the supply jet of a laminar proportional amplifier This sensor consists of a fluidic sensing and output transducer system with the appropriate electronic signal processing and readout The fluidic system is composed of a sensing amplifier and two pressure controlled oscillators (PCOs) The frequency output signals from the PCOs are monitored by using two inexpensive microphones and then converted to non-modulated output voltages by using two frequency-to-voltage converters These output voltages are then compared with a difference amplifier The output is displayed with a digital voltmeter and/or it could feed directly into the flight computer Preliminary test results indicate that this LASS can detect airspeeds between 0 to 12 m/s Author

A85-48072
ADVANCED AVIONICS FOR THE NEXT GENERATION MILITARY HELICOPTERS
 C BENNING, B BOYD, and B SKINNER (Texas Instruments, Inc., Defense Systems and Electronics Group, Dallas) Vertiflite (ISSN 0042-4455), vol 31, Sept-Oct 1985, p 24-27

A development status and integrability evaluation is conducted for state-of-the-art helicopter avionics that may be used in the U S Army's 'LHX' rotorcraft development program, with a view to target acquisition time reduction, improvements in mission reliability, and partial or complete automation of pilot functions Attention is given to a target acquisition subsystem incorporating a forward looking IR sensor and a daylight TV sensor, both of which are connected via high speed bus to the mission computer Also used will be integrated navigation, communication and identification avionics, aircraft survivability equipment capable of suppressing enemy radar and IR sensor-controlled weapons, and a very high speed IC-based flight computer O C

A85-48074
SIMPLIFYING THE COCKPIT
 D A BITTON (Astronautics Corporation of America, Milwaukee, WI) Vertiflite (ISSN 0042-4455), vol 31, Sept-Oct 1985, p 45-47

A development status and performance enhancement evaluation is made of a variety of proprietary advanced helicopter avionics and display system designs Among these are the

horizontal situation indicator and attitude director indicator CRT display, the former encompassing flight director cues, glidescope and localizer data, and turn and slip indicator, by means of which UH-60A Black Hawk helicopter pilots during the Grenada intervention obtained course and distance data. Attention is given to a range of CRT multifunction displays, which, as in the case of the 530MG display system, can facilitate nap-of-the-earth helicopter flight by overlaying vertical and horizontal steering commands, radar altitude, and terrain clearance, over forward looking IR sensor imagery. O C

A85-49003

EVALUATION OF THE BENEFITS OF ADVANCED AVIONICS SYSTEM TECHNOLOGIES THROUGH COMPUTER SIMULATION

R S LUCKEW, V L DUNCAN (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH), and R BRODERSON (Battelle Memorial Institute, Columbus, OH) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984. La Jolla, CA, Society for Computer Simulation, 1984, p 13-18

Attention is given to the approach employed by the U.S. Air Force's Wright Aeronautical Laboratories in the evaluation of advanced terrain-following/terrain-avoidance and threat-and-obstacle-avoidance concepts. This methodology simultaneously treats weather, terrain, and defenses as threats, while generating an optimal aircraft penetration path, this path is then converted into a realizable flight path by the BLUEMAX2 flight path generator, and the path data is fed into an 'attrition module' that calculates the probability of aircraft loss on the basis of the given aircraft and scenario. The entire scheme is noted to be adaptable to the examination of such other problems as those related to stealth, ECM, and combinations of these with terrain and threat avoidance techniques. O C

A85-49091

MEETING THE CHALLENGE OF ESM/ECM INTEGRATION

T H GREER (Litton Applied Technology, Systems Development Dept., Sunnyvale, CA) Defense Electronics (ISSN 0278-3479), vol 17, Sept 1985, p 74, 76, 78, 80, 82

Despite the inherent conflict between the basic functions of an airborne radar warning receiver (RWR) and an active onboard jammer system, there is a functional similarity in that both systems must monitor the electromagnetic environment and obtain emitter parameter data in order to perform their distinctly specialized functions. Examples of potential data flow between RWRs and jammers are presented to demonstrate that it is possible to minimize inherent functional conflicts and enhance individual system performance with a well-considered jammer/RWR interface. V L

A85-49949

WILL ADVANCED FIGHTER AVIONICS OPERATE WHEN NEEDED?

Aerospace Engineering (ISSN 0736-2536), vol 5, Sept 1985, p 28-32

Performance capabilities and availability of avionics systems for combat aircraft are discussed comparatively taking into account major recent improvements brought about through subsystem integration, information fusion, and hardware improvements. It is noted that the vulnerable and expensive unhardened Avionics Intermediate Shops, highly susceptible to battle damage, can be eliminated by introducing on-aircraft maintenance capability. Such issues as spare parts commonality and complexity and fault tolerance of multiple data processors are also addressed. It is concluded that availability of fighter avionics can be markedly improved by functionally pooling the multiple processing resources throughout the system as common system resources. L T

A85-50119

HEAD-UP DISPLAYS FOR GENERAL AVIATION

W D KYLE (Flight Dynamics, Inc., Hillsboro, OR) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985. 10 p (SAE PAPER 850902)

The state-of-the-art head-up display (HUD) designs whose incorporation by general aviation cockpit systems is discussed combine intuitive visual flying with essential instrumentation and continuity of visual and mental attention. The flight path vector HUD is especially useful during the critical transition from instrument to visual flight, or at those times when visual cues are either easily lost or nonexistent. O C

N85-34137#

Aeronautical Research Labs., Melbourne (Australia)

DETERMINATION OF INSTRUMENT ERRORS BY COMPATIBILITY CHECKING: RESULTS FROM DYNAMIC FLIGHT TEST DATA

R A FEIK Sep 1984. 30 p refs

(ARL/AERO-R-162, AR-003-968) Avail NTIS HC A03/MF A01

The considerable potential benefits of compatibility checking of aircraft dynamic flight data have in the past not been fully realized when applied to real data. It is suggested in this report that this is partly due to the presence of errors in the real data which are not usually accounted for in computer simulation studies. When factors such as accelerometer offset from center of gravity, measurement time delays and other non-linearities are accounted for, good results can be achieved with moderate quality instrumentation. The effect of these factors on the identified instrument errors are studied in this report and confidence in the results established by a careful comparison with instrument calibrations and expected errors. Other considerations, such as the influence of maneuver shape, the inclusion of altitude record, are also discussed, and the conditions for successful application of compatibility checking techniques to flight data are summarized. The importance of understanding the instrumentation system is highlighted. Author

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors, and on-board auxiliary power plants for aircraft.

A85-48073

A NEW ERA OF FUEL CONTROLS

L WATSON (Chandler Evans, Inc., East Hartford, CT) Vertiflite (ISSN 0042-4455), vol 31, Sept-Oct 1975, p 38, 39

The Adaptive Fuel Control unit destined for the T-800 turboshaft Advanced Technology Engine of the LHX helicopter program completed its initial flight evaluation in February, 1985. The unit's automatic and adaptive features enhanced the test vehicle's handling and reduced pilot workload, in keeping with LHX development goals. Also discussed is the EMC-32 Full Authority Digital Electronic Control system, which provides complete power management on all engine operating regimes, and combines full self-diagnostic capability with a simplified hydromechanical system design to minimize unit removals, reduce maintenance time, and cut engine response time in half. O C

07 AIRCRAFT PROPULSION AND POWER

A85-49021* National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
**A GENERALIZED COMPUTER CODE FOR DEVELOPING
DYNAMIC GAS TURBINE ENGINE MODELS (DIGTEM)**
C J DANIELE (NASA, Lewis Research Center, Cleveland, OH)
IN Aerospace simulation, Proceedings of the Conference, San
Diego, CA, February 2-4, 1984 La Jolla, CA, Society for Computer
Simulation, 1984, p 212-221 Previously announced in STAR as
N84-12166 refs

This paper describes DIGTEM (digital turbofan engine model), a computer program that simulates two spool, two stream (turbofan) engines DIGTEM was developed to support the development of a real time multiprocessor based engine simulator being designed at the Lewis Research Center The turbofan engine model in DIGTEM contains steady state performance maps for all the components and has control volumes where continuity and energy balances are maintained Rotor dynamics and duct momentum dynamics are also included DIGTEM features an implicit integration scheme for integrating stiff systems and trims the model equations to match a prescribed design point by calculating correction coefficients that balance out the dynamic equations It uses the same coefficients at off design points and iterates to a balanced engine condition Transients are generated by defining the engine inputs as functions of time in a user written subroutine (TMRSP) Closed loop controls can also be simulated DIGTEM is generalized in the aerothermodynamic treatment of components This feature, along with DIGTEM's trimming at a design point, make it a very useful tool for developing a model of a specific turbofan engine

B W

A85-49090
**ROLLS' TAY ENGINE MEETS SCHEDULE FOR GULFSTREAM
4 FIRST FLIGHT**

S W KANDEBO Aviation Week and Space Technology (ISSN
0005-2175), vol 123, Sept 23, 1985, p 103, 105, 107

The components of the Rolls-Royce Tay engine, which is to be used in the Gulfstream 4 and Fokker 100 aircraft, are discussed The fan section, which is composed of a 44-inch-diameter fan with 22 wide chord, solid snubberless blades, is described Low airflow noise generation and increased air intake were achieved by raising the bypass ratio of the engine to 3.1 The design and composition of the three-stage intermediate pressure compressor are discussed The features of the high-pressure turbine system, the airflow control system, and the combustion system are explained The maintenance schedule of the Tay engine is described The differences in the engine design for the two aircraft are presented

I F

A85-50112
PROP JET SINGLES HAVE ARRIVED

J A SCHWEIBOLD and M MOLISH, II (General Motors Corp., Allison Gas Turbine Div., Indianapolis, IN) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 10 p
(SAE PAPER 850882)

The development of turboprop and turboshaft engines for single and multiengine aircraft is discussed The initial development of small gas turbine engines and their use and the development of the first light turboprop aircraft are described The current turboprop and turboshaft engines were designed with a compact reserve air flow featuring a modular layout so they could be used in all single and multiengine aircraft A description of the system development for the engine, which concentrated on detail and practical development, is provided The modern turboprop engine is compact, lightweight, powerful, simple to operate, easy to maintain, and reliable It provides an aircraft with improved takeoff and landing performance, high climb and descent profiles, increased airspeed, a reduction in outside noise, and increased load A low cost turboprop engine, which retains all the high quality characteristics associated with a turboprop engine, is currently being developed

I F

A85-50114
**SINGLE-ENGINE PROPULSION IMPROVEMENT THROUGH
INTERCOOLING**

J H WELLS (Cessna Aircraft Co., Wichita, KS) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 8 p refs
(SAE PAPER 850894)

The use of air-to-air intercooling between a small aircraft engine's turbocharger and piston inlets allows operation at higher power with lean air-fuel mixtures, while observing cooling or detonation margin limitations, this represents specific fuel consumption improvements at a given output power Intercoolers can be selected from available cores, or sized specifically to suit airframe requirements The critical consideration for intercooler sizing is the critical altitude during maximum power climb O C

A85-50115
PORSCHE AIRCRAFT ENGINE P F M 3200

H BOTT and H DORSCH (Porsche AG, Weissach, West Germany) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 16 p
(SAE PAPER 850895)

A major automobile manufacturer is developing a family of general aviation aircraft engines for the 200-300 hp market, the first such engine to complete certification is a horizontally opposed six-cylinder design generating 212 hp at takeoff with full exhaust muffling, which employs fuel injection and is cooled by an engine-driven fan A noteworthy feature of this propulsion system is the pilot's ability to control engine power, speed, and fuel mixture to continually optimized values by means of a single lever Both AVGAS and MOGAS can be used as fuel The engine is distinguished by low operating cost, low exterior noise, minimum internal vibration and noise, and ease of control O C

A85-50120
**CONVERSION OF SMALL AIRCRAFT TO ALLISON TURBINE
POWER**

T F PIERCY (General Motors Corp., Allison Gas Turbine Div., Indianapolis, IN) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 12 p
(SAE PAPER 850906)

Allison Gas Turbine Division, General Motors Corporation, has produced over 20,000 Model 250 gas turbine engines While the major use of the engine to date has been the turboshaft version for helicopters, many turboprop applications exist and numerous new applications of the turboprop version are in process in the international market Based on the positive reception of the turboprop engine, Allison has begun a marketing program for the engine in the domestic fixed-wing aircraft market A major effort to date is the conversion by Allison of a Beechcraft Bonanza A-36 for use in demonstrations of the marked performance improvements with this new powerplant Author

A85-50121
**GARRETT TPE331-12 ENGINE PROVIDES IMPROVED
ALTITUDE PERFORMANCE FOR HIGH-SPEED EXECUTIVE
TURBOPROP AIRCRAFT**

H J KRASNOW (Garrett Turbine Engine Co., Phoenix, AZ) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 7 p
(SAE PAPER 850908)

A85-50122
AN ELECTRONIC LIMITER FOR AIRCRAFT ENGINES

A BROWN (Bendix-Avalex, Inc., St Laurent, Canada) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 8 p
(SAE PAPER 850910)

An Electronic Limiter System (ELS), which provides automatic torque and temperature limiting during the critical phase of flight by controlling the fuel controls governing pressure for an aerobatic turboprop engine, is discussed The operation of the ELS using its Electronic Limiter Unit (ELU), interface valve, shutoff valve,

and engine harness is described. The ELU contains the most advanced software system available; it can perform self tests, recover from simple failures, and recalibrate without using trim-pots. The ELU hardware consists of a digital board, an analog board, and a power board. A control algorithm based on a proportional plus integral control for limiting inputs of torque pressure, interturbine temperature, and propeller speed is explained. The performance tests results have demonstrated that with the ELS it is possible to extend the capabilities of conventional gas turbine fuel controls without using complete electronic systems. I F

A85-50132

AERODYNAMICS OF LIQUID-COOLED AIRCRAFT ENGINE INSTALLATIONS

S J MILEY (Texas A&M University, College Station) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr. 16-19, 1985 12 p refs
(SAE PAPER 850896)

A comparative evaluation is conducted of the aerodynamic characteristics of liquid-cooled aircraft engine installations with which experience has been gained, often as early as the Second World War. Attention is given to primary design considerations for inlets, diffusers, and warm air exit ports, with emphasis on air inlet aerodynamics and the characteristics of radiator core designs. Unique 'ring radiator' installations are noted which were originated by Kuchemann and Weber (1946). O C

N85-34138*# General Electric Co., Cincinnati, Ohio Aircraft Engine Business Group

HIGH PRESSURE COMPRESSOR COMPONENT PERFORMANCE REPORT

S J CLINE, W FESLER, H S LIU, R C LOVELL, and S J SHAFFER Sep 1983 170 p
(Contract NAS3-20643)
(NASA-CR-168245, NAS 1 26 168245, R82AEB437) Avail NTIS HC A08/MF A01 CSCL 21E

A compressor optimization study defined a 10 stage configuration with a 22.6:1 pressure ratio, an adiabatic efficiency goal of 86.1%, and a polytropic efficiency of 90.6%; the corrected airflow is 53.5 kg/s. Subsequent component testing included three full scale tests: a six stage rig test, a 10 stage rig test, and another 10 stage rig test completed in the second quarter of 1982. Information from these tests is used to select the configuration for a core engine test and an integrated core/low spool test. The test results will also provide data base for the flight propulsion system. The results of the test series with both aerodynamic and mechanical performance of each compressor build are presented. The second 10 stage compressor adiabatic efficiency was 0.848 at a cruise operating point versus a test goal of 0.846. E A K

N85-34139# Toronto Univ (Ontario) Inst for Aerospace Studies

A MODEL OF HYPERSONIC TWO-DIMENSIONAL OBLIQUE DETONATION WAVE RAMJET

Y SHENG and J P SISLIAN Jul 1985 27 p refs
(UTIAS-TN-257, ISSN-0082-5263, AD-B094375) Avail NTIS HC A03/MF A01

The possibility of using an oblique detonation wave ramjet as a power plant for a hypersonic vehicle is examined. The performance of a model of a two dimensional oblique detonation wave ramjet is analyzed in terms of thrust, lift and fuel consumption. Author

N85-34140*# General Electric Co., Cincinnati, Ohio Aircraft Engine Business Group

COMPONENT-SPECIFIC MODELING Annual Status Report

R L MCKNIGHT May 1985 162 p refs
(Contract NAS3-23687)
(NASA-CR-174765, NAS 1 26 174765, ASR-1) Avail NTIS HC A08/MF A01 CSCL 21E

A series of interdisciplinary modeling and analysis techniques that were specialized to address three specific hot section

components are presented. These techniques will incorporate data as well as theoretical methods from many diverse areas including cycle and performance analysis, heat transfer analysis, linear and nonlinear stress analysis, and mission analysis. Building on the proven techniques already available in these fields, the new methods developed will be integrated into computer codes to provide an accurate, and unified approach to analyzing combustor burner liners, hollow air cooled turbine blades, and air cooled turbine vanes. For these components, the methods developed will predict temperature, deformation, stress and strain histories throughout a complete flight mission. Author

N85-34141*# General Electric Co., Cincinnati, Ohio Aircraft Engine Business Group

ENERGY EFFICIENT ENGINE. FAN AND QUARTER-STAGE COMPONENT PERFORMANCE REPORT

S J CLINE, P H HALTER, J T KUTNEY, JR, and T J SULLIVAN Jan 1983 71 p refs
(Contract NAS3-20643)
(NASA-CR-168070, NAS 1 26 168070, R82AEB408) Avail NTIS HC A04/MF A01 CSCL 21E

The fan configuration for the general Electric/NASA Energy Efficient Engine was selected following an extensive preliminary design study. The fan has an inlet radius ratio of 0.342 and a specific flowrate of 208.9 kg/sec/sq m (42.8 lbm/sec/sq ft). The design corrected tip speed is 411.5 m/sec (1350 ft/sec) producing a bypass flow total-pressure ratio of 1.65 and a core flow total-pressure ratio of 1.6. The design bypass ratio is 6.8. The aerodynamic design point corresponds to the maximum climb power setting at Mach 0.8 and 10.67 Km (35,000 ft) altitude. The fully-instrumented fan component was tested in the Lynn Large Fan Test Facility in 1981. The overall performance results, reported herein, showed excellent fan performance with the fan meeting all of its component test goals of flow, efficiency and stall margin. Author

N85-34142# Rolls-Royce Ltd., Derby (England) Manufacturing Labs

PERFORMANCE IMPROVEMENTS FROM SURFACING IN AERO ENGINE COMPONENTS

J A S GRAHAM 8 Nov 1984 5 p Presented at Surface Eng Soc., Coventry, England, 8 Nov 1984
(PNR-90257) Avail NTIS HC A02/MF A01

Wear resistance of aircraft engine components is discussed, and abrasible linings, thermal barrier coatings, and controlled atmospheric spraying are reviewed. It is shown that application of surface treatments and protectives is a cost effective manufacturing approach to promote performance improvements, i.e., integrity and life. At the forefront of such techniques is the flame or thermal spraying technique. Author (ESA)

N85-34143# Rolls-Royce Ltd., Derby (England) Mechanical Technology Div

SHROUD SEGMENTS FOR UNSHROUDED BLADE TURBINES

R S ATTWOOD 1 Feb 1985 13 p
(PNR-90260) Avail NTIS HC A02/MF A01

The thermal requirements of shroud segments for unshrouded blade turbines were assessed by examining the thermal gradient through various types of section. For sections involving ceramic coatings, coating thickness required is defined and related to the cost in terms of cooling air flow. A limitation associated with the use of a compliant layer, as a result of its relatively low conductivity, is discussed. Transpiration of cooling air through the porous compliant layer is suggested. A method of comparative assessment of engine and ng thermal gradients and cycles was used to define a set of test conditions. Author (ESA)

07 AIRCRAFT PROPULSION AND POWER

N85-35194* National Aeronautics and Space Administration Langley Research Center, Hampton, Va
WINGTIP VORTEX PROPELLER Patent
J C PATTERSON, JR, inventor (to NASA) 6 Aug 1985 9 p
Filed 2 Feb 1984 Supersedes N84-20495 (22 - 11, p 1602)
(NASA-CASE-LAR-13019-1, US-PATENT-4,533,101,
US-PATENT-APPL-SN-576308, US-PATENT-CLASS-244-199,
US-PATENT-CLASS-244-55) Avail US Patent and Trademark
Office CSCL 01C

A device which increases the energy efficiency of aircraft wherein a wingtip pusher propeller is positioned aft of the wingtip to rotate in the crossflow of the wingtip vortex is presented. The propeller rotates against the vortex swirl creating additional thrust from and attenuating the wingtip vortex by simultaneously extracting energy from the vortex and converting it to propeller blade induced thrust while injecting its high energy wake into the vortex axial flow to dissipate the vortex. The device increases aircraft fuel efficiency by simultaneously increasing thrust and decreasing vortex induced drag. By attenuating the vortex safely to following aircraft is maximized.

Official Gazette of the U S Patent and Trademark Office

N85-35195* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
FLOW MODIFYING DEVICE Patent
J S KELM (General Electric Co, Cincinnati), E C VICKERS (General Electric Co, Cincinnati), J J WILLIAMS (General Electric Co, Cincinnati), and J R TAYLOR, inventors (to NASA) (General Electric Co, Cincinnati) 13 Aug 1985 10 p Continuation of abandoned US-Patent-AppI-SN-192677 filed 1 Oct 1980
(NASA-CASE-LEW-13562-2, US-PATENT-4,534,166,
US-PATENT-APPL-SN-500651, US-PATENT-CLASS-60-39 23,
US-PATENT-CLASS-60-748, US-PATENT-CLASS-239-402 5)
Avail US Patent and Trademark Office CSCL 21E

A swirler for a gas turbine engine combustor is disclosed for simultaneously controlling combustor flow rate, swirl angle, residence time and fuel-air ratio to provide three regimes of operation. A first regime is provided in which fuel-air ratio is less than stoichiometric, NO_x is produced at one level, and combustor flow rate is high. In a second regime, fuel-air ratio is nearly stoichiometric, NO_x production is less than that of the first regime, and combustor flow rate is low. In a third regime, used for example at highoff, fuel-air ratio is greater than stoichiometric and the combustor flow rate is less than in either of the other regimes.

Author

N85-35196 Purdue Univ, Lafayette, Ind
OPTIMALLY DESIGNED PROPELLERS CONSTRAINED BY NOISE Ph.D. Thesis
C J MILLER 1984 191 p
Avail Univ Microfilms Order No DA8507731

A design tool is developed that will produce an optimum propeller geometry for a given trade-off between noise and performance. A vortex model is used for the aerodynamics and a subsonic compact source model for the noise analysis. Optimizing the twist, chord and sweep distributions produced blades with favorable tradeoffs between noise and performance. The techniques used for noise reduction include an inboard loading shift, diameter reduction, rotational speed reduction, increased blade sweep, and blade number increase. The trade-offs for the optimized blades show that, for the straight blade, the most effective noise reduction method is to increase the blade number which both increases efficiency and decreases the blade number which both increases efficiency and decreases the noise. This is followed by blade sweep, which can decrease the noise up to 3 dBA with no efficiency loss, and rotational speed reduction, which reduces noise by 4 dBA per percent in efficiency loss. Results demonstrate that this design tool is not only effective, but useful in the search for more efficient and lower noise propulsion methods.

Dissert Abstr

N85-35197*# Pratt and Whitney Aircraft, East Hartford, Conn Engineering Div
ENERGY EFFICIENT ENGINE PROGRAM TECHNOLOGY BENEFIT/COST STUDY, VOLUME 1 Executive Summary
D E GRAY and W B GARDNER Oct 1983 19 p 2 Vol
(Contract NAS3-20646)
(NASA-CR-174766-VOL-1, NAS 1 26 174766-VOL-1,
PWA-5594-258-VOL-1) Avail NTIS HC A02/MF A01 CSCL 21E

Turbofan engine technologies required for the years 2000 to 2010 were studied, to assess the benefits of those technologies, and to formulate programs for developing the technologies required for that time period. Preliminary technology concepts that might be amenable to future development were ranked. Cycle studies, flowpath definition studies, and mechanical configuration studies were used to identify and establish the feasibility of the technologies that would be required in the 2000 to 2010 time frame. It is shown that a turbofan engine with advancements in aerodynamics, mechanical arrangements, and materials offer significant performance improvements over 1988 technology. The benefits of technologies are assessed using fuel burn and direct operating cost plus interest (DOC+I). The concepts could yield thrust specific fuel consumption benefits of almost 16%, fuel burn benefits of up to 24% and DOC+I benefits up to 14% in a long-range airplane relative to energy efficient engine technology levels. Technology development programs are formulated and recommended to realize those benefits.

E A K

N85-35198*# Pratt and Whitney Aircraft, East Hartford, Conn Engineering Div
ENERGY EFFICIENT ENGINE PROGRAM TECHNOLOGY BENEFIT/COST STUDY, VOLUME 2
D E GRAY and W B GARDNER Oct 1983 109 p refs 2 Vol
(Contract NAS3-20646)
(NASA-CR-174766-VOL-2, NAS 1 26 174766-VOL-2,
PWA-5594-251-VOL-2) Avail NTIS HC A06/MF A01 CSCL 21E

The benefit/cost study to identify turbofan engine technologies required for the years 2000 to 2010, the benefits of those technologies were formulated, and programs for developing the technologies required for that time period were formulated. It is shown that there are still many potential benefits to be realized from the advancement of gas turbine engine technology. Preliminary technology concepts that might be amenable to future development were ranked. Cycle studies, flowpath definition studies, and mechanical configuration studies were used to identify and establish the feasibility of the technologies that would be required in the 2000 to 2010 time frame. It is shown that a turbofan engine with advancements in aerodynamics, mechanical arrangements, and materials offers significant performance improvements over 1988 technology. The benefits of the technologies are assessed using fuel burn and direct operating cost plus interest (DOC+I).

E A K

N85-35199*# General Electric Co, Cincinnati, Ohio Aircraft Engine Business Group
ENERGY EFFICIENT ENGINE, HIGH PRESSURE TURBINE THERMAL BARRIER COATING. SUPPORT TECHNOLOGY REPORT
E C DUDERSTADT and P AGARWAL May 1983 128 p refs
(Contract NAS3-20643)
(NASA-CR-168037, NAS 1 26 168037, R82AEB293) Avail NTIS HC A07/MF A01 CSCL 21E

This report describes the work performed on a thermal barrier coating support technology task of the Energy Efficient Engine Component Development Program. A thermal barrier coating (TBC) system consisting of a Ni-Cr-Al-Y bond coat layer and ZrO₂-Y₂O₃ ceramic layer was selected from eight candidate coating systems on the basis of laboratory tests. The selection was based on coating microstructure, crystallographic phase composition, tensile bond and bend test results, erosion and impact test results, furnace exposure, thermal cycle, and high velocity dynamic oxidation test

results. Procedures were developed for applying the selected TBC to CF6-50, high pressure turbine blades and vanes. Coated HPT components were tested in three kinds of tests. Stage 1 blades were tested in a cascade cyclic test rig, Stage 2 blades were component high cycle fatigue tested to qualify thermal barrier coated blades for engine testing, and Stage 2 blades and Stage 1 and 2 vanes were run in factory engine tests. After completion of the 1000 cycle engine test, the TBC on the blades was in excellent condition over all of the platform and airfoil except at the leading edge above midspan on the suction side of the airfoil. The coating damage appeared to be caused by particle impingement, adjacent blades without TBC also showed evidence of particle impingement. B W

08

AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities, piloting, flight controls, and autopilots

A85-47253#

ACTIVE CONTROL OF THE BUFFETING RESPONSE ON A LARGE MODERN CIVIL AIRPLANE CONFIGURATION IN WIND TUNNEL

R DESTUYNDER (ONERA, Chatillon-sous-Bagneux, France) (International Symposium on Aeroelasticity and Structural Dynamics, 2nd, Aachen, West Germany, Apr 1-3, 1985) ONERA, TP, no 1985-26, 1985, 9 p (ONERA, TP NO 1985-26)

A large half wing, aeroelastic model of a civil transport aircraft has been built to study the unsteady aerodynamic response of active flaperons in the S1 ONERA wind tunnel. Then, after analyzing the buffet envelope at large angles of attack in a large range of Mach numbers, it was decided to implement an active control to reduce the dynamic wing response due to the buffeting phenomenon. It was designed as a multicontrol system, operating on the various eigen modes of the wing structure by introduction of unsteady aerodynamic damping forces generated by a flaperon motion. The amount of damping which was achieved in the wind tunnel tests shows that a significant improvement can be expected from this control system, regarding fatigue stresses, passenger and crew comfort and extension of the flight envelope. Author

A85-47688* National Aeronautics and Space Administration Langley Research Center, Hampton, Va
FEEDBACK CONTROL FOR FUEL-OPTIMAL DESCENTS USING SINGULAR PERTURBATION TECHNIQUES

D B PRICE (NASA, Langley Research Center, Hampton, VA) IN. 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 198-203

In response to rising fuel costs and reduced profit margins for the airline companies, the optimization of the paths flown by transport aircraft has been considered. It was found that application of optimal control theory to the considered problem can result in savings in fuel, time, and direct operating costs. The best solution to the aircraft trajectory problem is an onboard real-time feedback control law. The present paper presents a technique which shows promise of becoming a part of a complete solution. The application of singular perturbation techniques to the problem is discussed, taking into account the benefits and some problems associated with them. A different technique for handling the descent part of a trajectory is also discussed. G R

A85-47696

DESIGN OF OPTIMAL LOW-SENSITIVITY CONTROLLERS WITH PRESPECIFIED EIGENVALUES - APPLICATION TO AIRCRAFT LATERAL MOTION

N N SORIAL (Alexandria, University, Egypt) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 384-386 refs

This paper considers the design of an optimal controller to an aircraft performing a lateral maneuver. The closed-loop system has a prescribed set of eigenvalues. Moreover, the closed-loop system is optimal with respect to quadratic performance index and/or its trajectory sensitivity with respect to small variations in the plant parameters from their nominal values. The predicted responses of the resulting closed-loop system are determined for nominal and perturbed plant parameters. The results show that the closed-loop system preserves the achieved properties even in the presence of small deviations in system parameters. Author

A85-47697

DESIGN OF DECOUPLED LONGITUDINAL FLIGHT CONTROL LAWS UTILIZING EIGENSYSTEM ASSIGNMENT

K M SOBEL and E Y SHAPIRO (Lockheed-California Co., Burbank, CA) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 403-408 refs

Eigenstructure assignment and command generator tracking are applied to the design of pitch pointing and vertical translation control laws for the AFTI F-16 aircraft. The desired eigenvectors are chosen based upon performance and sensitivity considerations. Feedforward command tracking gains are computed to ensure steady state following to the pilot's command. An interesting feature of the design is that both modes may be implemented using the same feedback gains. Furthermore, the aircraft exhibits a conventional response with acceptable handling qualities when a flaperon failure occurs. Author

A85-47701

DESIGN OF A PITCH ORIENTATION CONTROL SYSTEM FOR AIRCRAFT CONTROL IN STALL REGION

M M KULKARNI and V N JOSHI (Indian Institute of Technology, Bombay, India) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 434-439 refs

A pitch orientation control system (POCS) has been developed for T-tail aircraft experiencing control reversal with pitch-up in unstable flight regimes. The design approach was based on the short period transfer function for a system of simplified equations having two degrees of freedom. The transfer function describes the situation in which a pole and a zero appear in the right hand control plane. A system of eight dynamic compensators is included to provide stable control in prestall and poststall conditions. The results of a computer simulation of the proposed scheme showed that stable control can be obtained using only one compensator parameter value for the prestall and poststall regimes, respectively. I H

A85-47702

AN ADAPTIVE CONTROL OF AN ELECTRO-HYDRAULIC POSITION CONTROL SYSTEM

M M KULKARNI, D B TRIVEDI, and J CHANDRASEKHAR (Indian Institute of Technology, Bombay, India) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1 New York, IEEE, 1984, p 443-448. refs

In a hydraulic system input/output relation of the control valve is nonlinear and load dependent. An adaptive control would therefore be necessary for large changes in load parameter. The paper considers a position control system. This becomes a third order system under inertia load and with compressibility of oil considered. Load pressure and integration of the load pressure are suggested as additional feedbacks. PRBS is used as the input signal and the cross-correlation technique is used for identification of the impulse response. Performance parameters are defined and then they are brought to their respective model parameters by

08 AIRCRAFT STABILITY AND CONTROL

iteratively adjusting the gains of the additional feedback loops. An 8-bit microprocessor based system has been useful for identification and control. The proposal seems practical and can be economically implemented. Author

A85-47717

HOW AUTOPILOT REQUIREMENTS CONSTRAIN THE AERODYNAMIC DESIGN OF HOMING MISSILES

F W NESLINE and M L NESLINE (Raytheon Co., Missile Systems Div., Bedford, MA). IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 2. New York, IEEE, 1984, p. 716-730. refs

When an aerodynamically controlled missile is used in a homing application, the transfer function of the vehicle becomes part of an overall homing and attitude control feedback loop. Therefore, the missile must be designed so that its aerodynamics meet the constraints required to accomplish homing successfully. For radar homing, these constraints are stringent enough to require an autopilot that controls the aerodynamic transfer function using body instruments and internal feedback loops. Even with an autopilot, there are limits on the aerodynamic moment parameters such as M -alpha and M -delta that must be considered at the very beginning of the missile system design. This paper explores the nature and sources of these limits and presents numerical examples to illustrate what kinds of numbers are required. Author

A85-47734

FURTHER APPLICATION OF OUTPUT PREDICTIVE ALGORITHMIC CONTROL TO TERRAIN FOLLOWING

M E BISE (Lear Siegler, Inc., Astronics Div., Dayton, OH) and J G REID (Systems Control Technology, Inc., Dayton, OH). IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 2. New York, IEEE, 1984, p. 937-942. refs

The utilization of Output Predictive Algorithmic Control (OPAC) in precision trajectory control is discussed. The design of OPAC, which is a flexible closed-loop system that performs prediction, desired future reference trajectory, and future control calculations in every cycle, is presented. The TTYLON program which computes aircraft dynamics, is described. The Trajectory Controller/Observer Design Aid System (TCODAS) software that controls the design and analysis of the control system is explained. The TTYLON Program was used to design a linearized math model of the F-111/MAW and multiple input control surfaces which was tested and proved suitable for low altitude flying. Both the 35-degree and 58 degree wing sweep models followed the programmed trajectory exactly. The 35-deg model had less oscillations in outparts, due to more direct lift, which resulted in a smoother ride. IF

A85-47788

A FLUIDIC FLIGHT CONTROL SYSTEM DEMONSTRATOR

R L WOODS (Texas, University, Arlington). IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 3. New York, IEEE, 1984, p. 1691-1694. refs (Contract N00019-81-C-0351)

This paper presents the concepts and test results of a single-axis fluidic flight control system demonstrator. This demonstrator has a pilot input handle, a fluidic control circuit with an angular rate sensor for feedback, and a fluidic-input servoactuator. Long fluid transmission lines interconnect the three components as they would be in an aircraft. The hydraulic servoactuator can be driven by inputs from the handle or from the motion of the controller containing the rate sensor and thus illustrates the basic control actions necessary for flight control. The experimental test results presented show that the static gain of the system is correct with a position hysteresis of 1.2 percent and a noise of 1.5 percent peak-to-peak. The bandwidth of the system is 1.5 Hz under the limited conditions of the test. The system has the performance expected of a flightworthy control system. Author

A85-47789

PERFORMANCE EVALUATION OF AN ELECTROFLUIDIC FLIGHT CONTROL ACTUATOR

D R KEYSER (U.S. Navy, Naval Air Development Center, Warminster, PA). IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 3. New York, IEEE, 1984, p. 1695-1700. refs

The feasibility of providing fluidic backup control of a fly-by-wire actuator was demonstrated in the laboratory. The concept is compatible with the Navy's Advanced Flight Control Actuation System and offers a realistic approach for providing control after loss of primary flight control caused by electromagnetic pulse or interference. Laboratory testing demonstrated how fluidics can enhance the survivability of fly-by-wire control systems. The test results also demonstrated that this design will provide satisfactory performance for flight testing in the T-2C Technology Demonstrator aircraft. Author

A85-47790

FLUIDICS - A RELIABLE ALTERNATIVE FOR AIRCRAFT CONTROL

R BENOIT (Grumman Aerospace Corp., Bethpage, NY). IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 3. New York, IEEE, 1984, p. 1701-1707.

The development of fluidic flight control systems (FCS) for aircraft stabilization is discussed. Since the present Fly-By-Wire (FBW) system is susceptible to electronic interference, a nonelectric backup system is necessary. The fluidic system uses laminates, each performing a specific function, to provide sensing, computing, and controlling for the aircraft. Hydraulic oil from the basic hydraulic system is used for sensing and signal transmission. Particular emphasis is placed on the development of fluidic actuators. Fluidic FCS were compared to mechanical systems and FBW systems and proved to be the lightest, most cost effective, and best stabilizing backup system. IF

A85-49011

FORWARD-SWEPT WING CONTROL SYSTEM DEVELOPMENT

D WALLER and J BOUDREAU (Grumman Aerospace Corp., Bethpage, NY). IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984. La Jolla, CA, Society for Computer Simulation, 1984, p. 92-106.

Attention is given to the X-29 Forward Swept Wing research aircraft's Flight Control System (FCS). Flight Simulation Facility with emphasis on implementation problems encountered that relate to this unique aircraft's specific features and the 'pilot in loop' requirement. The FCS's hardware/software simulator test configuration interfaces the X-29 flight simulator to the aircraft's flight control hardware. Mathematical models incorporated in the simulation system include those for the airframe and human (pilot) factors. Four different, basic strategies are used to determine model assignment: maximum realism, maximum dynamic accuracy, minimum number of interfaces, and minimum amount of software maintenance. OC

A85-49128#

THE THEORETICAL MINIMUM INDUCED DRAG OF THREE-SURFACE AIRPLANES IN TRIM

E R KENDALL (Gates Learjet Corp., Wichita, KS). Journal of Aircraft (ISSN 0021-8669), vol. 22, Oct. 1985, p. 847-854. Previously cited in issue 20, p. 2853, Accession no. A84-41337. refs

A85-49132*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif.

HANDLING QUALITIES RELATED TO STALL/SPIN ACCIDENTS OF SUPERSONIC FIGHTER AIRCRAFT

S B ANDERSON (NASA, Ames Research Center, Moffett Field, CA). Journal of Aircraft (ISSN 0021-8669), vol. 22, Oct. 1985, p. 875-880. Previously cited in issue 20, p. 2855, Accession no. A84-42346. refs

A85-49139*# Kansas Univ , Lawrence

THEORY OF WING ROCK

C-H HSU and C E LAN (Kansas, University, Lawrence) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct. 1985, p 920-924. Previously cited in issue 07, p. 857, Accession no A85-19583 refs

(Contract NAG1-134)

A85-49172

THE DELCO PERFORMANCE MANAGEMENT SYSTEM

P MOORE and D M PAGE (British Caledonian Airways, Ltd., Crawley, England) Journal of Navigation (ISSN 0020-3009), vol 38, Sept 1985, p 413-422

Design, use and performance features of the Delco transport aircraft performance management system (PMS) for flight economy during ascent, cruise and descent flight phases are described. PMS controls pitch and thrust and is composed of three LRUs: the control display, computer and the switching units. A soft altitude hold is implemented to maintain steady drag in the face of environmental vagaries and the economy gains from not resetting the power levels. Yielding a 1-3 percent fuel saving, the system is projected to repay its cost in a little over a year. An initial 3 mos training program, including simulator time, is combined with refresher courses to ensure full use of PMS during all flight phases. Test operational applications of PMS revealed the benefits of variable-speed climb. M S K

A85-50123

A FULL-TIME YAW DAMPER FOR THE STARSHIP FLYING SCALE PROTOTYPE

L R JOHNSON (Beech Aircraft Corp., Wichita, KS) and S. S. YANG (Beech Aircraft Corp., Wichita, Wichita State University, KS) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 8 p (SAE PAPER 850912)

A flight test yaw damper for Dutch roll damping improvement has been designed for the Starship flying scale prototype. An analytical study was also performed using linear analysis of a wide variety of flight conditions. Flight test results confirmed a noticeable improvement in ride qualities with the yaw damper engaged. An unexpected benefit was improved directional handling qualities during deep-stall testing. Author

A85-50124* National Aeronautics and Space Administration Langley Research Center, Hampton, Va

SIMULATION STUDY OF AN AUTOMATIC TRIM SYSTEM FOR REDUCING THE CONTROL FORCES ON A LIGHT TWIN AFTER AN ENGINE FAILURE

E C STEWART and P W BROWN (NASA, Langley Research Center, Hampton, VA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 16 p refs (SAE PAPER 850913)

An automatic trim system for reducing the control forces after an engine failure on a light twin has been investigated on the Langley General Aviation Simulator. The system schedules open-loop trim tab deflections as a function of differential propeller slipstream dynamic pressure and freestream dynamic pressure. The system is described and the airplane-system static and dynamic characteristics are documented. Three NASA research pilots evaluated the effectiveness of the system for takeoff and landing maneuvers. A variety of off-nominal system characteristics were studied. The system was judged to be generally beneficial, providing a 2 to 3 point improvement in pilot rating for the tasks used in the evaluations. Author

A85-50125

IMPROVED CAPABILITIES OF THE NEW GENERAL AVIATION DIGITAL AUTOPILOTS

D M SAMPSON (Rockwell International Corp., Cedar Rapids, IA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 10 p (SAE PAPER 850914)

Digital autopilots are the final link in the introduction of digital avionics equipment to the general aviation market. Although previous analog autopilot systems generally provide excellent performance, digital systems possess many advantages not possible in general aviation analog autopilot systems. Digital autopilots, now available from various manufacturers, benefit from less weight, less cost, fewer wires, enhanced diagnostic capabilities, and enhanced performance. This paper explores these advantages using the Collins APS-85 as an example of an advanced general aviation digital autopilot. Author

N85-34144*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

GROUND-BASED AND IN-FLIGHT SIMULATOR STUDIES OF FLIGHT CHARACTERISTICS OF A TWIN-FUSELAGE PASSENGER TRANSPORT AIRPLANE DURING APPROACH AND LANDING

W D GRANTHAM, P M SMITH (PRC Kentron, Inc.), W R NEELY, JR (AFSC Liaison Office, Hampton, Va.), P L DEAL, and K R YENNI Sep 1985 55 p refs (NASA-TP-2451, L-15941, NAS 1 60 2451) Avail NTIS HC A04/MF A01 CSCL 01C

Six-degree-of-freedom ground-based and in-flight simulator studies were conducted to evaluate the low-speed flight characteristics of a twin-fuselage passenger transport airplane and to compare these characteristics with those of a large, single-fuselage (reference) transport configuration similar to the Lockheed C-5A airplane. The primary piloting task was the approach and landing task. The results of this study indicated that the twin-fuselage transport concept had acceptable but unsatisfactory longitudinal and lateral-directional low-speed flight characteristics, and that stability and control augmentation would be required in order to improve the handling qualities. Through the use of rate-command/attitude-hold augmentation in the pitch and roll axes, and the use of several turn coordination features, the handling qualities of the simulated transport were improved appreciably. The in-flight test results showed excellent agreement with those of the six-degree-of-freedom ground-based simulator handling qualities tests. As a result of the in-flight simulation study, a roll-control-induced normal-acceleration criterion was developed. The handling qualities of the augmented twin-fuselage passenger transport airplane exhibited an improvement over the handling characteristics of the reference (single-fuselage) transport. B W

N85-35200* National Aeronautics and Space Administration Langley Research Center, Hampton, Va

DUAL TOWLINE SPIN-RECOVERY DEVICE Patent

W L WHITE, inventor (to NASA) 3 Sep 1985 9 p Filed 15 Sep 1983 Supersedes N83-34934 (21 - 23, p 3738) (NASA-CASE-LAR-13076-1, US-PATENT-4,538,778, US-PATENT-APPL-SN-532342, US-PATENT-CLASS-244-75-R, US-PATENT-CLASS-244-139, US-PATENT-CLASS-244-113) Avail US Patent and Trademark Office CSCL 01C

A device which corrects aerodynamic spin is described wherein a parachute exerts antispin forces on an aircraft to effect spin recovery. The dual parachute towlines and are each attached to the parachute and are attached to the rear fuselage equidistant to and on opposite sides of the aircraft centerline. As the parachute is deployed during spin, the parachute force acts through only the towing and exerts its force outboard of center on the aircraft. As a result, the parachute exerts not only an antispin torque, but additionally causes the aircraft to roll, creating a gyroscopic antispin rolling moment. The additional antispin rolling moment facilitates spin recovery by permitting a relatively smaller parachute to accomplish spin recovery equivalent to that of a larger parachute.

08 AIRCRAFT STABILITY AND CONTROL

attached to the center of the rear fuselage
Official Gazette of the U S Patent and Trademark Office

N85-35201*# Purdue Univ , Lafayette, Ind School of Aeronautics and Astronautics
THE INTEGRATED MANUAL AND AUTOMATIC CONTROL OF COMPLEX FLIGHT SYSTEMS Semiannual Status Report, Jan. - Aug. 1985

D K SCHMIDT 17 Sep 1985 112 p refs
(Contract NAG4-1)
(NASA-CR-176166, NAS 1 26 176166) Avail NTIS HC A06/MF A01 CSCL 01C

Pilot/vehicle analysis techniques for optimizing aircraft handling qualities are presented. The analysis approach considered is based on the optimal control frequency domain techniques. These techniques stem from an optimal control approach of a Neal-Smith like analysis on aircraft attitude dynamics extended to analyze the flared landing task. Some modifications to the technique are suggested and discussed. An in depth analysis of the effect of the experimental variables, such as prefilter, is conducted to gain further insight into the flared land task for this class of vehicle dynamics. E R

N85-35202*# Purdue Univ , Lafayette, Ind
ANALYSIS OF FLEXIBLE AIRCRAFT LONGITUDINAL DYNAMICS AND HANDLING QUALITIES. VOLUME 1: ANALYSIS METHODS

M R WASZAK and D S SCHMIDT Jun 1985 111 p refs
(Contract NAG1-254)
(NASA-CR-177943-VOL-1, NAS 1 26 177943-VOL-1) Avail NTIS HC A06/MF A01 CSCL 01C

As aircraft become larger and lighter due to design requirements for increased payload and improved fuel efficiency, they will also become more flexible. For highly flexible vehicles, the handling qualities may not be accurately predicted by conventional methods. This study applies two analysis methods to a family of flexible aircraft in order to investigate how and when structural (especially dynamic aeroelastic) effects affect the dynamic characteristics of aircraft. The first type of analysis is an open loop modal analysis technique. This method considers the effects of modal residue magnitudes on determining vehicle handling qualities. The second method is a pilot in the loop analysis procedure that considers several closed loop system characteristics. Volume 1 consists of the development and application of the two analysis methods described above. B W

N85-35203*# Purdue Univ , Lafayette, Ind
ANALYSIS OF FLEXIBLE AIRCRAFT LONGITUDINAL DYNAMICS AND HANDLING QUALITIES. VOLUME 2: DATA

M R WASZAK and D K SCHMIDT Jun 1985 243 p
(Contract NAG1-254)
(NASA-CR-177943-VOL-2, NAS 1 26 177943-VOL-2) Avail NTIS HC A11/MF A01 CSCL 01C

Two analysis methods are applied to a family of flexible aircraft in order to investigate how and when structural (especially dynamic aeroelastic) effects affect the dynamic characteristics of aircraft. The first type of analysis is an open loop modal analysis technique. This method considers the effect of modal residue magnitudes on determining vehicle handling qualities. The second method is a pilot in the loop analysis procedure that considers several closed loop system characteristics. Both analyses indicated that dynamic aeroelastic effects caused a degradation in vehicle tracking performance, based on the evaluation of some simulation results. Volume 2 consists of the presentation of the state variable models of the flexible aircraft configurations used in the analysis applications mode shape plots for the structural modes, numerical results from the modal analysis frequency response plots from the pilot in the loop analysis and a listing of the modal analysis computer program. B W

N85-35204*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va
A PRELIMINARY EVALUATION OF A FAILURE DETECTION FILTER FOR DETECTING AND IDENTIFYING CONTROL ELEMENT FAILURES IN A TRANSPORT AIRCRAFT
W T BUNDICK Jul 1985 85 p refs
(NASA-TM-87576, NAS 1 15 87576) Avail NTIS HC A05/MF A01 CSCL 01C

The application of the failure detection filter to the detection and identification of aircraft control element failures was evaluated in a linear digital simulation of the longitudinal dynamics of a B-737 Aircraft. Simulation results show that with a simple correlator and threshold detector used to process the filter residuals, the failure detection performance is seriously degraded by the effects of turbulence. Author

09

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways, aircraft repair and overhaul facilities, wind tunnels, shock tube facilities, and engine test blocks

A85-47161#
AN AEROELASTIC TESTING TECHNIQUE IN A STRAIGHT CASCADE WIND-TUNNEL

E SZECHENYI and PH GIRAULT (ONERA, Chatillon-sous-Bagneux, France) IN Measuring techniques for transonic and supersonic flow in cascades and turbomachines, Proceedings of the Seventh Symposium, Aachen, West Germany, September 21-23, 1983. Aachen, Institut fuer Strahlantriebe und Turboarbeitsmaschinen, 1984, p 4-1 to 4-8

ONERA's straight cascade wind-tunnel situated in Modane can simulate two-dimensionally the transonic flow inside compressors at inlet Mach numbers varying from 0.5 to 1.0 and supersonic flow at Mach numbers of 1.2 and 1.4. Reynolds number simulation can be achieved by varying the tunnel pressure between the limits of 1.4 and 3 bar. The test cascade consists of six airfoil blades. Of these, the two central blades can be made to vibrate either in pitching or in heaving, though the test technique only requires one blade to vibrate. The possible frequencies of vibration are designed to simulate as far as possible the actual reduced frequencies of compressor blades. The unsteady aerodynamic measurements are made by means of pressure transducers mounted inside the airfoils. The pressure signals are treated digitally so as to give unsteady lift, moment, and pressure distributions in quasi-real time. Author

A85-48523
EUROPEAN WORKSHOP ON PROBE CALIBRATIONS

K -D BROICHHAUSEN, ED (Aachen, Rheinisch-Westfaelische Technische Hochschule, West Germany) and T FRANSSON, ED (Lausanne, Ecole Polytechnique Federale, Switzerland) Aachen, West Germany, Institut fuer Strahlantriebe und Turboarbeitsmaschinen (Mitteilung, No 84-02), 1984, 123 p. No individual items are abstracted in this volume.

Probe calibrations are presented for wind tunnel measurements of supersonic and transonic flow in turbomachines. Consideration is given to results from recent calibrations of the WP-11 wedge probe for the following wind-tunnel parameters: pitch angle coefficient, stagnation pressure coefficient, and static pressure coefficient. The design characteristics of a cone-shaped probe, the CP-L, are discussed. Calibration diagrams are presented for CP-L measurements in different nozzle configurations. Schematic diagrams of the probe calibration rigs are provided. I H

A85-48856

WHY NOT HAVE A SIMULATOR TYPE FOR COMMUTER OPERATORS?

S ANDERSON (Rediffusion Simulation, Ltd., Crawley, England) ICAO Bulletin, vol. 40, May 1985, p 12, 14, 15.

Almost all recurrent and conversion training can be carried out in a flight simulator, saving money and fuel, and limiting dangers of in-flight training. However, the high cost of the equipment and the lack of specific legislation have led to the exclusion of small commuters or regional operators from the use of flight simulators. The requirements and details of a projected scaled-down version of a flight simulator, advanced enough to replace the aircraft, but at a price justifiable to operators of smaller aircraft, than a commercial airliner, are discussed. The Seagull simulation computer system is described. I S

A85-48857

CAUTRA ATC SIMULATOR STRIVES FOR REALISM

A PEYTAVIN (Direction Generale de l'Aviation Civile, Service Technique de la Navigation Aeronne, Paris, France) ICAO Bulletin, vol. 40, May 1985, p 16-19

The initial and advanced training for air traffic controllers provided by ENAC (Ecole Nationale de l'Aviation Civile) is assisted by systematic use of the CAUTRA simulator, designed as a subsystem of the operational CAUTRA (Coordonnateur Automatique de Traffic Aerien) air traffic control system installed by ENAC in Toulouse. The CAUTRA simulator feeds simulation facilities, installed at all large French traffic control centers via the national telecommunications network. All new elements related to the airspace and aeronautical procedures that appear in the operational system are reproduced in the simulator subsystem. The components of the CAUTRA simulator, such as computers, telephony link, radar display, printers, etc., are described in detail. The School has 34 simulator positions, with a network comprising 37 remote positions. Currently 1500 exercises are available which represent 40,000 aircraft movements. The experiments carried out on the simulator may be designed to validate new airspace organization plans, the reorganization of the tasks of controllers' manning a control position, or even the design of the controllers' work stations. I S

A85-48858

ADVANCED FLIGHT TRAINING OFFERED TO CORPORATE AVIATORS

E J SOWA (SimuFlite Training International, Inc., Dallas, TX) ICAO Bulletin, vol. 40, May 1985, p 20-22

The SimuFlite Training International flight training complex at the Dallas/Fort Worth International Airport uses new Phase-II level simulators and a new Line-Oriented Flight Training Operational approach to create realistic on-ground aircraft-flying experience. A Phase-II simulator employs a six-degree-of-freedom aircraft motion system, and accurately simulates near-ground, on-the-ground, and in-flight characteristics. It simulates the effects of crosswind, wind shear, wet and icy runway conditions and tire failures. The business-jet simulators employed at the training complex and capable of meeting the FAA Phase-II training requirements for operators of business/executive type aircraft, include SimuFlite's Learjet 35/36 system, and the simulators replicating the Learjet 55, Gulfstream III, Westwind 2, and Citation I/II. Simulators for the King Air 200 and Hawker-Siddeley 125-700 are soon scheduled for operation. I S

A85-48859

GENERAL AVIATION NEEDS COST-EFFECTIVE FLIGHT SIMULATORS

D A LOMBARDO (Frasca International, Inc., Champaign, IL) ICAO Bulletin, vol. 40, May 1985, p 23-25

Frasca's Models 141, 142, and 240 of fixed-wing GA aircraft, the GA helicopter simulators for Bell 206, Bell 212, and a VFR hover simulator were tested and are used in Frasca's model flight school situated at its own airport. In addition to these computer-based simulators, a new computer system, called computer interaction flight simulation (CIFS), has been recently

developed under contract with NASA. In addition to normal simulator functions, CIFS provides many other possibilities. Multiple simulators, connected to a single instructor console will allow dramatically increased productivity, while the computer performs all record-keeping and grades student performance, allowing the instructor to be much more productive and creative. I S

A85-49001

AEROSPACE SIMULATION; PROCEEDINGS OF THE CONFERENCE, SAN DIEGO, CA, FEBRUARY 2-4, 1984

M UNG, ED (Southern California, University, Los Angeles) La Jolla, CA, Society for Computer Simulation (Simulation Series, vol. 13, Feb 1984), 1984, 229 p. For individual items see A85-49002 to A85-49021

Among the topics discussed are the simulated flight ground testing of avionics systems, recent advancements in computer image generation, rotorcraft simulation systems at NASA's Ames facility, real time structural mode simulation, the Large Amplitude Multi-Mode Aerospace Research Simulator's application to the Advanced Fighter Technology Integration F-16, the dynamics and control simulation of large space structures, and real time models of flexible space structure dynamics. Also treated are the role of simulation in the development of the fuel-efficient B 757 and B 767 airliners, modeling techniques for transonic airfoils, the principles of optimal missile guidance and control system design, guidance and control simulations for laser-guided weapons, polarimetric radar simulation, and a code for dynamic gas turbine engine models. O C

A85-49002

FLIGHT TESTING OF AVIONIC SYSTEMS ON THE GROUND

M UNG (Southern California, University, Los Angeles) and J UNDERWOOD, JR (USAF, Edwards AFB, CA) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984. La Jolla, CA, Society for Computer Simulation, 1984, p 3-12. refs

The Integration Facility for Avionic Systems Testing (IFAST) allows prospective U S Air Force avionics systems to be debugged in the course of ground-simulated flights prior to actual flight testing. IFAST uncovers problems with a given system through playback computer analysis of mission data from tapes that were recorded during simulated missions. Attention is given to IFAST's physical plant, the time-shared computer complex configuration and communications systems, and the modes of mission analysis operation. O C

A85-49004

THE DISPLAY SUBSYSTEM IN THE AIRCRAFT SIMULATOR - SIMULATE OR STIMULATE?

J L ARCHDEACON and D B STIMSON IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984. La Jolla, CA, Society for Computer Simulation, 1984, p 19-26

Since avionics display subsystems are becoming more important in advanced aircraft cockpits, display subsystem performance is of unprecedented significance. Aircraft simulators may implement such a display subsystem either by integrating the display hardware and software into the simulator, or by simulating the subsystem by means of a general purpose computer and graphics system. Attention is given to the cases of operational flight trainers, cockpit procedure trainers, and engineering simulators. O C

A85-49006* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif
ROTORCRAFT SIMULATION AT AMES

T S ALDERETE (NASA, Ames Research Center, Moffett Field, CA) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984. La Jolla, CA, Society for Computer Simulation, 1984, p 39-49. refs

Attention is given to rotorcraft simulation experience at NASA's Ames research facility, which has involved complex mathematical modeling, high computational capability requirements, and strong influences from pilot motion and visual cues. A development history

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and performance assessment is presented for the rotorcraft simulation hardware, together with projections of near term development improvements of capabilities. Greater demand is anticipated for the simulation of all-digital helicopter flight control systems. O C

A85-49019

ADVANCES IN FLIGHT SIMULATORS

J A SCHEPP (Singer Co., Link Flight Simulation Div., Binghamton, NY) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984. La Jolla, CA, Society for Computer Simulation, 1984, p 192-206

The primary impact of microprocessor development on flight training simulator design may be the encouragement of system architecture configurations in which computational functions associated with each major system are decoupled from each other. The systems are then complete with respect to both hardware and software, the only remaining links between simulator subdivisions are the paths by which common data are transmitted between major functions in a clearly identified and controlled global bus system. O C

A85-49020

THE HISTORY AND FUTURE CONTRIBUTIONS OF CARCO SIMULATORS TO THE AEROSPACE INDUSTRY

J M CARTER (Carco Electronics, Menlo Park, CA) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984. La Jolla, CA, Society for Computer Simulation, 1984, p 207-211

A development history is presented for three-axis flight simulators designed for use in manned spacecraft and high performance missile and aircraft-related development programs. In order to satisfy gimbal stiffness, high mechanical resonance, good mechanical damping and low inertia, simulator gimbals fabricated from magnesium are used. Analog control systems remain popular with many users of these simulators. O C

A85-49906

APPLYING SHEAR BEAM LOAD MEASURING TECHNIQUES TO PORTABLE PLATFORM SCALES FOR AIRCRAFT WEIGHING

H NELSON (WEICO Corp., Lynnwood, WA) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984. 18 p (SAWE PAPER 1581)

An Aircraft Weighing System (AWS), in which the load weight is measured by sensitive shear deflection in the weighing platform structure, is described. Five portable components, the number of each determined by the types of aircraft to be weighed, compose the AWS: the platform scales, the scale access ramps, the spacer platforms, the cable assemblies, and the digital system electronics. One cable assembly connects each scale to the computer, which provides prompts, displays the gross weight to within 0.10 percent and the center of gravity to within 0.20 percent on the alpha-numeric display unit, and provides a printed record. The computer can also interface with the on-board WBMS for the purpose of calibration from the ground, by use of a special interface card. Block diagrams are included. I S

A85-49908

THE ROLE OF LOAD-CELL ROTATION IN AIRPLANE-WEIGHT DETERMINATION

E J GAUTHIER (Boeing Commercial Airplane Co., Seattle, WA) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984. 7 p (SAWE PAPER 1583)

Attention is given to a method of determining acceptable accuracy limits for an aircraft weighing test, and applying the acceptance criteria in such a way as to determine whether test results are acceptable or indicate that testing should continue. Acceptance testing includes a weighing process that involves physically moving the scales along the airplane jack points between the individual weighings. In multiple weighings, weight will appear to change and the center of gravity will appear to move, an analysis

of the system allows the correlation of apparent center of gravity movement with weighing accuracy. O C

A85-49947

SHOULD THEY FEEL JUST LIKE FLYING?

J H BRAHNEY Aerospace Engineering (ISSN 0736-2536), vol 5, Sept 1985, p 9-15

General capabilities and limitations of the existing ground-based flight simulators are reviewed. Attention is paid to synergistic six-degrees-of-freedom systems, Large-Amplitude Multimode Aerospace Simulator (LAMARS)-type systems, and the centrifuge-based Dynamic Flight Simulator (DFS). Their relative merits, such as the g onset rates, versatility, and complexity are discussed. The discussion also covers military rotorcraft simulators, which are capable of reproducing the nap-of-the-earth mission and low-altitude formation flights environment. Finally, the U.S. Air Force's Total In-Flight Simulator and the NT-33A in-flight simulator are described. L T

A85-49948

SIMULATORS - HOW REAL DOES THE VISUAL SYSTEM NEED TO BE?

D J HOLT Aerospace Engineering (ISSN 0736-2536), vol 5, Sept 1985, p 16-22

An assessment is made of the degree of realism obtainable by means of computer-generated imagery (CGI) in state-of-the-art military aircraft mission simulators. CGI allows geographic data obtained from the U.S. Defense Mapping Agency or other intelligence sources to be programmed and projected in visually realistic terms, so that the pilot using the simulator can fly through a given region and get a strong sense of the terrain and other surface features, enemy tanks and aircraft, moreover, can be superposed on the given landscape to give a full combat scenario. O C

N85-35205 Texas Univ., Austin

A STUDY OF THE CONTROL OF PARTICULATE EMISSIONS FROM TURBINE ENGINE TEST CELLS Ph.D. Thesis

J E STEVENS, JR 1984. 197 p

Avail. Univ. Microfilms. Order No. DA8508364

The United States Air Force has been cited in California for violation of visible opacity standards by the test cell buildings used for aircraft engine run-up during major engine overhaul. Recommendations to control emissions by conventional means, such as electrostatic precipitation or high-energy scrubbers with demisters, were deemed non-cost-effective (130 test cells at more than 1 million dollars per cell). As an alternative control measure, EPA Method 5 particulate sampling was used to characterize stack emissions during the incremental addition of cooling water to the engine exhaust/augmentator air discharge. Six water increments, from 230 (baseline) to 1200 gallons per minute, were tested. Increasing water injection rates to 801 gallons per minute significantly reduced engine-contributed test cell emissions for the J75-17 engine to 0.05 pounds particulate per million Btu. Water injection at 801 gallons per minute therefore represents the best available control technology for turbine engine test cells testing the J75 engine. Dissert. Abstr.

N85-35208# Naval Surface Weapons Center, White Oak, Md. MACH 14 FLOW RESTRICTOR THERMAL STRESS ANALYSIS Final Report, Jan. - Apr. 1984

E J BECKER Aug 1984. 380 p. Original contains color illustrations. (AD-A156215, NSWC/TR-84-364) Avail. NTIS HC A17/MF A01 CSCL 14B

The objective of this study was to determine the effects of heating and mechanical pressure loading on the flow restrictor plate used in the Mach 14 leg of NSWC/WO hypervelocity Wind Tunnel. Included in this report are the procedures for model generation using PATRAN-G, model translation into ABAQUS format, transient heat transfer analysis, thermal stress analysis, results translation from ABAQUS to PATRAN-G, and the method used to determine the heat transfer film coefficients needed for

ABAQUS The results of these analyses are reviewed and recommendations are made for future analyses GRA

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ASTRONAUTICS

Includes astronautics (general), astrodynamics, ground support systems and facilities (space), launch vehicles and space vehicles, space transportation, spacecraft communications, command and tracking, spacecraft design, testing and performance, spacecraft instrumentation, and spacecraft propulsion and power

A85-47057

IUS-1 - REDUNDANT INERTIAL MEASUREMENT UNIT TEST PLAN AND RESULTS

L W MUELLER, L DUBBERKE (Aerospace Corp, Los Angeles, CA), and J VOLGER (USAF, Space Div, Los Angeles, CA) IN Aerospace Applications Conference, Vail, CO, January 28-February 4, 1984, Digest New York, IEEE, 1984, p 59-77

The Redundant Inertial Measurement Unit (RIMU) of the Inertial Upper Stage (IUS) rocket of the Shuttle has been tested according to a plan developed jointly by NASA and the USAF. The tests were carried out at the Eastern Launch Site (ELS) 16 hours before launch and consisted of five on pad calibrations and alignments (cal/aligns). RIMU gyrocompass alignments were compared to a reference optical alignment, and trend data were calculated. Comparison of the trend data showed that the difference between the RIMU cal/aligns and the reference alignments was within the maximum allowable range of error of ± 0.325 arcsec. The location of the RIMU in the IUS avionics bay is shown in a diagram. I H

A85-47306

MINIMAX OPTIMAL CONTROL AND ITS APPLICATION TO THE REENTRY OF A SPACE GLIDER

A MIELE and P VENKATARAMAN (Rice University, Houston, TX) IN Recent advances in the aerospace sciences New York, Plenum Press, 1985, p 21-40 refs (Contract NSF ENG-79-18667)

Minimax problems of optimal control are presently converted into Mayer-Bolza problems of the calculus of variations by means of a transformation technique that requires the proper augmentation of the state vector, the control vector, and the parameter vector, as well as the proper augmentation of the constraining relations. By means of this transformation, the unknown minimax value of the performance index becomes a component of the vector parameter. Numerical results are obtained by means of the sequential gradient-restoration algorithm for solving optimal control problems on digital computers, attention is given to the hypervelocity regime in an exponential atmosphere, for a reentry glider whose trajectory is controlled by means of the angles of attack and banking. O C

A85-49016* National Aeronautics and Space Administration Johnson (Lyndon B.) Space Center,

SOME REAL-TIME SIMULATION APPLICATIONS TO SPACE SHUTTLE APPROACH AND LANDING DESIGN AND TEST

H G LAW, III and H W STEGALL (NASA, Johnson Space Center, Houston, TX) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984 La Jolla, CA, Society for Computer Simulation, 1984, p 155-170 refs

In the present discussion of the roles played by real time, man-in-the-loop engineering simulation in the development of NASA Space Shuttle approaches and landings, attention is given to the function of the simulator as a design and verification tool. Aspects of the problem posed by Shuttle landings, and the difficulties involved in this problem's quantification, are noted. Recent results of control system studies for pitch axis control, using fixed- and motion-base simulators, are discussed. O C

A85-49435

DESCENT VEHICLES (SPUSKAEMYE APPARATY)

B M PANKRATOV Moscow, Izdatel'stvo Mashinostroenie, 1984, 232 p In Russian refs

The work examines the current status of design methods (including CAD) used in the development of descent vehicles intended for landing on planets of the solar system and for return to earth from orbits and interplanetary trajectories. The appropriate aerodynamic schemes are analyzed, and attention is given to methods for determining the main design parameters for ballistic, gliding, and sliding descent vehicles. Problems of thermal protection are discussed, and strength calculations are presented for fuel, instrument-payload, and engine systems. Finally, the use of a specially constructed descent vehicle to simulate the entry of a meteoroid into the earth's atmosphere is considered. B J

A85-49448

ORBIT CONTROL OF A SYNCHRONOUS SATELLITE [UPRAVLENIE ORBITOI STATSIONARNOGO SPUTNIKA]

G M CHERNIAVSKII, V A BARTENEV, and V A MALYSHEV Moscow, Izdatel'stvo Mashinostroenie, 1984, 144 p In Russian refs

The choice of a control strategy for the transfer of a synchronous satellite (SS) from the injection longitude to the operating longitude is considered. Attention is given to methods for controlling the longitudinal and latitudinal position of an SS with an accuracy that meets international standards. Particular consideration is given to the change in stationary-orbit elements under impulse control, the use of low thrust to transfer an SS, and stabilization of the orbital position of an SS. B J

N85-35223*# Lockheed Missiles and Space Co, Huntsville, Ala Research and Engineering Center

RESULTS OF TESTS OF THE SRB AFT SKIRT HEAT SHIELD CURTAIN IN THE MSFC HOT GAS FACILITY

W G DEAN Feb 1982 64 p refs

(Contract NAS8-32982)

(NASA-CR-170888, NAS 1 26 170888, LMSC-HREC-TM-D784643) Avail NTIS HC A04/MF A01 CSCL 21H

During the first two space shuttle flights the aft skirt heat shield curtain performed well during ascent but failed during reentry. This exposed the inside of the skirt and its subsystems to reentry heating. The resulting exposure damaged various expensive systems items and therefore a curtain reassessment is required. As a part of this reassessment, tests were conducted in the MSFC Hot Gas Facility (HGF). The purposes of these tests were to determine if the curtain would fail in a manner similar to that in flight and to demonstrate that meaningful tests of the curtain can be conducted in the HGF. Author

N85-35224*# Lockheed Missiles and Space Co, Huntsville, Ala Research and Engineering Center

RESULTS OF TESTS OF MTA-2 TPS ON THE SRB HOLD-DOWN BOLT BLAST CONTAINER

W G DEAN 30 Jun 1982 13 p

(Contract NAS8-32982)

(NASA-CR-170891, NAS 1 26 170891, LMSC-HREC-TN-D867571) Avail NTIS HC A02/MF A01 CSCL 21H

The four solid rocket booster (SRB) hold-down posts are fastened to the mobile launch platform (MLP) with four large nuts. At liftoff the nuts are split with explosive charges to release the SRB/Shuttle. A blast container is placed over the nuts to protect the vehicle from flying debris. The blast container is a reusable part and has to be protected from aerodynamic heating during flight. The thermal protection system (TPS) used to protect these blast containers is cork. Fitting the flat cork sheet to this hemispherical shaped blast container is both time consuming and expensive. Another problem is removing the charred cork and epoxy glue from the blast containers. Replacements of this cork with another TPS material such as MTA-2 was examined. Heating rates along the centerline of the forward facing areas of the blast container were determined. The feasibility of using 1/2 in. MTA-2

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on the SRB blast containers for protection from ascent, plume impingement and reentry heating is demonstrated E A K

11

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general), composite materials, inorganic and physical chemistry, metallic materials, nonmetallic materials, and propellants and fuels

A85-47973

EFFECT OF TEMPERATURE ON THE FATIGUE AND FRACTURE PROPERTIES OF 7475-T761 ALUMINUM

J M COX, D E PETTIT, and S L LANGENBECK (Lockheed-California Co, Burbank) IN Fatigue at low temperatures, Proceedings of the Symposium, Louisville, KY, May 10, 1983 Philadelphia, PA, ASTM, 1985, p 241-256 refs

The effect of low-temperature toughness degradation on damage tolerance and life analysis methodology is discussed. Spectrum fatigue and fatigue crack growth tests were conducted and life predictions made on 7475-T761 aluminum. The retardation behavior was determined by conducting constant K single overload fatigue crack growth tests. The low-temperature environment (-54 C) improved the life of fatigue and fatigue crack growth tests subjected to several loading spectra. This may be partially attributable to stronger retardation effects at low temperatures. It is concluded that low temperature may be a factor in damage tolerance and life analysis only under certain conditions. Author

A85-47974

LOW TEMPERATURE AND LOADING FREQUENCY EFFECTS ON CRACK GROWTH AND FRACTURE TOUGHNESS OF 2024 AND 7475 ALUMINUM

P R ABELKIS, M B HARMON, E L HAYMAN, T L MACKAY (Douglas Aircraft Co, Long Beach, CA), and J ORLANDO IN Fatigue at low temperatures, Proceedings of the Symposium, Louisville, KY, May 10, 1983 Philadelphia, PA, ASTM, 1985, p 257-273 Research sponsored by the McDonnell Douglas Independent Research and Development Program refs

An experimental program was conducted to investigate the effect of low temperature (219 K) on the crack growth and fracture toughness of two aluminum alloys, 2024-T351 and 7475-T7651. Crack growth tests were performed with center-cracked panels and constant-amplitude and spectrum loadings. The spectrum represented a transport wing lower surface. The results show the 2024 alloy properties at low temperature to be equal to or better than the properties of that alloy at room temperature (RT), whereas some of the 7475 alloy properties decreased. In addition, tests were performed at RT and low temperature on 2024-T3 to evaluate the effect of loading frequency on crack growth. The results indicated a faster crack growth rate at lower frequencies. Author

A85-48274*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala

SUPERALLOY MICROSTRUCTURAL VARIATIONS INDUCED BY GRAVITY LEVEL DURING DIRECTIONAL SOLIDIFICATION

M H JOHNSTON, P A CURRERI, R A PARR, and W S ALTER (NASA, Marshall Space Flight Center, Huntsville, AL) Metallurgical Transactions A - Physical Metallurgy and Materials Science (ISSN 0360-2133), vol 16A, Sept 1985, p 1683-1686 refs

The Ni-base superalloy MAR-M246 (Hf) was directionally solidified during low gravity maneuvers aboard a NASA KC-135 aircraft. Gravity force variations during this process yielded a concomitant variation in microstructure and microsegregation. Secondary dendrite arm spacings are noted to be larger in the low-g portion, this, in turn, decreases the extent of interdendritic segregation. The amount of Hf in both the carbides and interdendritic eutectic increases as the gravity force diminishes. Fewer carbides are present in the low-g regions. O C

A85-48562

FIBRE REINFORCED COMPOSITES '84; PROCEEDINGS OF THE INTERNATIONAL CONFERENCE, UNIVERSITY OF LIVERPOOL, ENGLAND, APRIL 3-5, 1984

Conference sponsored by the Plastics and Rubber Institute London, Plastics and Rubber Institute, 1984, 332 p For individual items see A85-48563 to A85-48574

Among the topics discussed are phenolic resin matrix composites for high temperature and fire-exposure applications, novel resins for fiber-reinforced composite productivity improvement, the use of engineering textiles for mechanical property improvement in composites, the significance of aramid fiber reinforcement in composites, the energy absorption properties of Sheet Metal Compounds (SMCs) under crash conditions, and SMC impact behavior variations with temperature. Also covered are CFRP applications in high performance structures, composite helicopter main rotor blade technology, composite vehicular leaf springs, carbon fiber-reinforced thermoplastics, filament winding development status, the injection processing of fiber-reinforced thermoplastics, civil aircraft composite structure certification, composite radomes, design procedures for short fiber-reinforced thermoplastics, the strength limitations of mechanically fastened lap joints, environmental fatigue and creep in glass-reinforced materials, the effects of moisture on high performance laminates, the environmental behavior of SMC, and corrugated composites. O C

A85-48568

APPLICATION OF CARBON FIBRE REINFORCED THERMOPLASTIC (PEEK) COMPOSITE TO AERO ENGINE COMPONENT MANUFACTURE

G A OWENS and D J LIND (Rolls-Royce, Ltd, Derby, England) IN Fibre reinforced composites '84, Proceedings of the International Conference, Liverpool, England, April 3-5, 1984 London, Plastics and Rubber Institute, 1984, p 12.1-12.11 refs

Comparative physical and mechanical property data is presented and discussed for various thermoplastic and thermoset polymers and their carbon fiber reinforced composites. The potential advantages offered by PEEK Aromatic Polymer Composites (APC) and their current limitations for use in aero engine applications are outlined. In order to assess the advantages and the problems to be overcome in using such material, a preliminary evaluation program is described involving the manufacture of a nonstructural aero engine component. Author

A85-48572

CONTINUOUS FIBRE REINFORCED THERMOPLASTICS IN NEW GENERATION RADOMES

C K HALL (British Aerospace, PLC, Dynamics Group, Stevenage, England) IN Fibre reinforced composites '84, Proceedings of the International Conference, Liverpool, England, April 3-5, 1984 London, Plastics and Rubber Institute, 1984, p 19.1-19.13 Research supported by British Aerospace, PLC refs

The paper discusses the use of thermoplastics for radome applications. The thermoplastics examined are those grouped generically as polyarylates, and in particular polyetheretherketone (PEEK). Properties of the matrices and reinforcements are given, and the four elements of radome design considerations are discussed: electrical, structural, environmental and manufacture. The manufacturing process utilizes modified stacking techniques and press moulding for glass fiber composites and powder sintering for PEEK syntactic foams. Author

A85-48758

THERMAL STABILITY OF PLASMA-SPRAYED ZIRCONIA COATINGS AS RELATED TO SUBSTRATE SELECTION

F VASILIU, I PENCEA, V MANOLIU, I DINCA (Institutul National pentru Creatie Stiintifica si Tehnica, Bucharest, Romania), and C SARBU (Institute for Physics and Technology of Materials, Bucharest, Romania) American Ceramic Society Bulletin (ISSN 0002-7812), vol 64, Sept 1985, p 1268-1271 refs

Plasma-sprayed zirconia coatings deposited on refractory substrates (Ni superalloys, AISI 314 steel) were subjected to

thermal cycling tests to evaluate the influence of substrate selection on the thermal stability of the coating. The Y₂O₃ and MgO-stabilized ZrO₂ coatings, in general, perform better than CaO-stabilized coatings. The degradation and failure of a given thermal barrier system depends on the substrate used. Thermal cycling data are discussed in connection to the results of SEM and X-ray mapping investigations. Possible reasons for premature spalling of stabilized ZrO₂ coatings on certain substrates are suggested. Author

A85-49901

ADHESIVE SEALING FOR INTEGRAL FUEL TANKS

F W AULD (General Dynamics Corp., Fort Worth, TX) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 14 p. (SAWE PAPER 1573)

A significant degree of weight reduction was recently achieved for the F-16 fighter's integral fuel tanks in the course of a manufacturing technology development program. This two-part effort involved, first, the modification and evaluation of the existing 'Scotch-Weld' system to verify performance improvements obtainable at lower manufacturing costs. Then, two full scale fuselage integral fuel tank assemblies were sealed with the new product and subjected to a comprehensive cost comparison study without a break in the production flow. O C

A85-49905

THE WEIGHT REDUCTION POTENTIAL OF ADVANCED COMPOSITES

P W SCOTT (Douglas Aircraft Co., Long Beach, CA) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 18 p. refs (SAWE PAPER 1579)

Attention is given to the weight-reduction potential of carbon/epoxy tape and cloth, Kevlar/epoxy cloth, and boron/epoxy tape, in various ply arrangements. These advanced composites are compared to aluminum and E-glass epoxy performance under compression and shear loading. Tension-loaded structural weights are also compared, assuming damage tolerance criteria, and an analysis is conducted for those cases in which rigidity is critical for deflection and/or flutter considerations. Forty cases of aircraft structural components that were first constructed of conventional materials and then redesigned using advanced composites, thereby yielding empirical weight reduction data, are evaluated in light of analytical weight reduction potentials. O C

A85-50116

CERTIFICATION OF RECIPROCATING ENGINE AIRCRAFT OILS AND ADDITIVES BY SUPPLEMENTAL TYPE CERTIFICATION PROCEDURES

W E GARRELTS and H A POITZ (Illinois, University, Urbana) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 10 p. refs (SAE PAPER 850899)

The steps of the process by which an aircraft piston engine oil is developed and certified are traced, from its origin in the perception of a need for an oil possessing improved characteristics, through development to the standards set by existing specifications, to testing which yields manufacturers' approval and FAA certification, and finally, marketing. Emphasis is given to current difficulties in the achievement of 150-hour oil qualification engine tests, as well as to relative cost of an oil's approval procedure. O C

N85-34222*# Sikorsky Aircraft, Stratford, Conn

FLIGHT SERVICE EVALUATION OF COMPOSITE HELICOPTER COMPONENTS Contractor Final Report, May 1982 - Sep. 1983

M J RICH and D W. LOWRY Apr 1985 116 p. refs (Contract NAS1-16542) (NASA-CR-172562, NAS 1 26 172562, SER-510117) Avail NTIS HC A06/MF A01 CSCL 11D

An assessment of composite helicopter structures, exposed to environmental effects, after four years of commercial service is presented. This assessment is supported by test results of helicopter components and test panels which have been exposed

to environmental effects since late 1979. Full scale static and fatigue tests are being conducted on composite components obtained from S-76 helicopters in commercial operations in the Gulf Coast region of Louisiana. Small scale tests are being conducted on coupons obtained from panels being exposed to outdoor conditions in Stratford, Connecticut and West Palm Beach, Florida. The panel layouts represent S-76 components. Moisture evaluations and strength tests are being conducted, on the S-76 components and panels, over a period of eight years. Results are discussed for components and panels with up to four years of exposure. Author

N85-34279# Rolls-Royce Ltd., Derby (England)

DIRECTIONALLY SOLIDIFIED GAS TURBINE ALLOYS

P R BEELEY (Leeds Univ.) and D DRIVER 1 Feb 1985 51 p. refs (PNR-90264) Avail NTIS HC A04/MF A01

Progress in directional solidification of superalloys, and applications to aircraft engine turbine blades are reviewed. Superalloy metallurgy and blade design, casting techniques for directional solidification, alloy development for conventional casting, and single crystal alloys are discussed. Author (ESA)

N85-34280* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

FIRE-RESISTANT PHOSPHORUS CONTAINING POLYIMIDES AND COPOLYIMIDES Patent

J A MIKROYANNIDIS, inventor (to NASA) (National Academy of Sciences - National Research Council, Washington, D C) 20 Aug 1985 12 p. Filed 16 Aug 1984 Supersedes N85-21363 (23 - 12, p 1812) Continuation-in-part of US-Patent-Appl-SN-522629, 12 Aug 1983 (NASA-CASE-ARC-11522-2, US-PATENT-4,536,565, US-PATENT-APPL-SN-641143, US-PATENT-CLASS-528-352, US-PATENT-CLASS-528-168, US-PATENT-CLASS-528-229, US-PATENT-CLASS-528-353) Avail US Patent and Trademark Office CSCL 11C

Phosphorus-containing polyimides and copolyimides are synthesized in a two-step polycondensation reaction from 1-(diorganoxyphosphonyl)methyl 2,4- and 2,6-diaminobenzenes and tetracarboxylic anhydride. The diorgano position of the diorganoxyphosphonyl group includes alkyl, such as ethyl, substituted alkyl, such as 2-chloroethyl, and aryl such as phenyl. The tetracarboxylic anhydrides include compounds such as pyromellitic dianhydride and benzophenone tetracarboxylic dianhydride. The glass transition temperature (T_g) of the polyimides is reduced by incorporation of the (dialkoxypolyphosphonyl)methyl groups. The phosphorus-containing copolyimides show a considerably higher degree of fire-resistance as compared to that of the corresponding common polyimides.

Official Gazette of the U.S. Patent and Trademark Office

N85-34295*# Akron Univ., Ohio Dept of Chemical Engineering

MEASUREMENT AND CORRELATION OF JET FUEL VISCOSITIES AT LOW TEMPERATURES Final Report

D L SCHRUBEN Aug 1985 31 p. refs (Contract NAG3-488) (NASA-CR-174911, NAS 1 26 174911) Avail NTIS HC A03/MF A01 CSCL 21D

Apparatus and procedures were developed to measure jet fuel viscosity for eight current and future jet fuels at temperatures from ambient to near -60 C by shear viscometry. Viscosity data showed good reproducibility even at temperatures a few degrees below the measured freezing point. The viscosity-temperature relationship could be correlated by two linear segments when plotted as a standard log-log type representation (ASTM D 341). At high temperatures, the viscosity-temperature slope is low. At low temperatures, where wax precipitation is significant, the slope is higher. The breakpoint between temperature regions is the filter flow temperature, a fuel characteristic approximated by the freezing point. A generalization of the representation for the eight experimental fuels provided a predictive correlation for

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low-temperature viscosity, considered sufficiently accurate for many design or performance calculations E A K

N85-35233* National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio
THERMAL BARRIER COATING SYSTEM Patent
S STECURA, inventor (to NASA) 13 Aug 1985 5 p Filed 14 Aug 1984 Supersedes N84-33595 (22 - 23, p 3724) Continuation-in-part of US Patent-4,485,151, US Patent-Appl-SN-523297, filed 16 Aug 1983, and continuation-in-part of abandoned US Patent-Appl-SN-375784, filed 6 May 1982
(NASA-CASE-LEW-14057-1, US-PATENT-4,535,033, US-PATENT-4,485,151, US-PATENT-APPL-SN-640712, US-PATENT-APPL-SN-523297, US-PATENT-APPL-SN-375784, US-PATENT-CLASS-428-633, US-PATENT-CLASS-428-656, US-PATENT-CLASS-428-678, US-PATENT-CLASS-428-679, US-PATENT-CLASS-428-680, US-PATENT-CLASS-428-681, US-PATENT-CLASS-428-682) Avail US Patent and Trademark Office CSCL 11D

An oxide thermal barrier coating comprises ZrO_3 - Yb_2O_3 that is plasma sprayed onto a previously applied bond coating. The zirconia is partially stabilized with about 124 w/o ytterbia to insure cubic, monoclinic, and tetragonal phases.

Official Gazette of the U S Patent and Trademark Office

N85-35236* Lockheed Missiles and Space Co., Huntsville, Ala Research and Engineering Center
SRB THERMAL PROTECTION SYSTEMS MATERIALS TEST RESULTS IN AN ARC-HEATED NITROGEN ENVIRONMENT
C J WOJCIECHOWSKI Aug 1979 62 p refs
(Contract NAS8-32982)
(NASA-CR-170881, NAS 1 26 170881, LMSC-HREC-TM-D697786) Avail NTIS HC A04/MF A01 CSCL 11D

The external surface of the Solid Rocket Booster (SRB) will experience imposed thermal and shear environments due to aerodynamic heating and radiation heating during launch, staging and reentry. This report is concerned with the performance of the various TPS materials during the staging maneuver. During staging, the wash from the Space Shuttle Main Engine (SSME) exhaust plumes impose severe, short duration, thermal environments on the SRB. Five different SRB TPS materials were tested in the 1 MW Arc Plasma Generator (APG) facility. The maximum simulated heating rate obtained in the APG facility was 248 Btu/sq ft/sec, however, the test duration was such that the total heat was more than simulated. Similarly, some local high shear stress levels of 0.04 psia were not simulated. Most of the SSME plume impingement area on the SRB experiences shear stress levels of 0.02 psia and lower. The shear stress levels on the test specimens were between 0.021 and 0.008 psia. The SSME plume stagnation conditions were also simulated. B W

N85-35237* Lockheed Missiles and Space Co., Huntsville, Ala Research and Engineering Center
RESULTS OF VARIABLE ENTHALPY TESTS OF CPR-488 TIP PANELS IN MSFC HOT GAS FACILITY
W G DEAN 22 Feb 1982 37 p
(Contract NAS8-32982)
(NASA-CR-170889, NAS 1 26 170889, LMSC-HREC-TM-D784773) Avail NTIS HC A03/MF A01 CSCL 11D

Tests were conducted to determine the effects of variable enthalpy levels on CPR-488 foam performance and/or recession. Also to be determined was whether the BX-250 thickness indicator plugs (TIP) concept is feasible for measuring recession rates of CPR-488 foam during external tank flight. The tests determined that the TIP plug idea works. The accuracy of the indicated recession depth is approximately \pm or \pm 1.16 in. The BX-250 plugs with TiO_2 work better than the regular BX-250 plugs. Also, there is an effect of enthalpy on CPR-488 foam performance. E R

N85-35239* Lockheed Missiles and Space Co., Huntsville, Ala Research and Engineering Center

RESULTS OF TESTS OF WEATHERED K5NA CLOSEOUT MATERIAL IN THE MSFC HOT GAS FACILITY

W G DEAN 6 Aug 1982 24 p
(Contract NAS8-32982)
(NASA-CR-170893, NAS 1 26 170893, LMSC-HREC-TN-D867576) Avail NTIS HC A02/MF A01 CSCL 11D

The application of K5NA over hypalon was investigated. The effects of using K5NA over painted cork surfaces, the effects of weathering on the unpainted K5NA surfaces are determined, and the use of water versus solvent for tooling K5NA in place were compared. It is concluded that (1) K5NA can be applied to hypalon surfaces, (2) K5NA can be left unpainted, and (3) K5NA can be tested with water or solvent. E A K

N85-35241* Lockheed-California Co., Burbank **FUEL CONTAINMENT AND DAMAGE TOLERANCE FOR LARGE COMPOSITE PRIMARY AIRCRAFT STRUCTURES. PHASE 1: TESTING Contractor Report, Oct. 1981 - Jan. 1983**

J P SANDIFER Mar 1983 501 p refs
(Contract NAS1-16856)
(NASA-CR-166091, NAS 1 26 166091, LR-30380-PHASE-1) Avail NTIS HC A22/MF A01 CSCL 11D

Technical problems associated with fuel containment and damage tolerance of composite material wings for transport aircraft were identified. The major tasks are the following: (1) the preliminary design of damage tolerant wing surface using composite materials, (2) the evaluation of fuel sealing and lightning protection methods for a composite material wing, and (3) an experimental investigation of the damage tolerant characteristics of toughened resin graphite/epoxy materials. The test results, the test techniques, and the test data are presented. E A K

N85-35257* Dayton Univ., Ohio **ASPECTS OF HIGH-RESOLUTION GAS CHROMATOGRAPHY AS APPLIED TO THE ANALYSIS OF HYDROCARBON FUELS AND OTHER COMPLEX ORGANIC MIXTURES. VOLUME 1 Final Report, Jan. - Sep. 1980**

W A RUBEY Wright-Patterson AFB, Ohio AFWAL Feb 1985 213 p
(Contract F33615-77-C-2004)
(AD-A156154, UDR-TR-82-156-VOL-1, AFWAL-TR-84-2096-VOL-1) Avail NTIS HC A10/MF A01 CSCL 21D

Turbine engine fuels are complex mixtures of hydrocarbons which have until recently, been obtained almost exclusively from petroleum. There is growing interest in developing alternative feedstocks for the eventual production of high-quality turbine engine fuels. The major analytical technique for separating the chemical constituents and analyzing fuels and synfuel feedstocks is high-resolution gas chromatography (HRGC), and the extreme chemical complexity of these hydrocarbon mixtures continues to challenge even the most sophisticated HRGC techniques. Therefore, the principal objective of this research was to identify and evaluate advanced HRGC instrumental procedures which show potential for improving the analysis of hydrocarbon jet fuels and various feedstocks. A gas chromatograph can be viewed as an assembly of individual components arranged to form a time invariant linear system. Accordingly, a systems approach has been used in this investigation to study, refine, and modify HRGC instrumentation. GRA

N85-35308* Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio **NITROGEN ANALYSIS BY CHEMILUMINESCENCE Final Report, Aug. 1982 - Dec. 1983**

R C STRIEBICH Apr 1985 37 p
(AD-A156197, AFWAL-TR-84-2089) Avail NTIS HC A03/MF A01 CSCL 21D

With high overall accuracy, a chemiluminescent detector can easily measure low ppm nitrogen levels in model mixtures and shale-derived jet fuel distillates. Forty model mixtures were analyzed.

using an Antek Model 720C chemiluminescent detector to demonstrate the absolute accuracy and precision of the instrument. A severely hydrotreated shale JP-4 jet fuel was blended with selected model mixtures to obtain six fuels ranging from less than 1 to approximately 150 parts-per-million added nitrogen. Total nitrogen analysis was then accomplished by two different chemiluminescent detection systems, as well as by the micro-Kjeldahl and microcombustion methods. Results clearly point out the ability of the chemiluminescent method to measure the nitrogen level of low ppm shale-derived aviation turbine fuel.

GRA

12

ENGINEERING

Includes engineering (general), communications, electronics and electrical engineering, fluid mechanics and heat transfer, instrumentation and photography, lasers and masers, mechanical engineering, quality assurance and reliability, and structural mechanics

A85-47060

A WIDEBAND X100 LOW NOISE MICROWAVE FREQUENCY MULTIPLIER

H ENDLER (Systron Donner Corp., Microwave Div., Van Nuys, CA) IN Aerospace Applications Conference, Vail, CO, January 28-February 4, 1984, Digest New York, IEEE, 1984, p 107-116

A low-noise X100 frequency multiplier chain has been built for use in an airborne radar exciter/downconverter assembly. The input frequency band is 91-94 MHz, and the output frequency band is 9100-9400 MHz. The integrated downconverter assembly includes dual receiver channels made from low-noise GaAs FETs, X-band preamplification, intermediate frequency filtering, and amplification. The entire assembly is packaged for installation in combat aircraft and occupies less than 135 cubic inches. The phase noise spectral density of the X100 multiplier is given for various frequencies in the range 1 MHz-100 Hz. Black and white photographs of the exciter downconverter assembly are provided.

IH

A85-47082

A NEW SINGLE FILAMENT SMOKE TUBE INJECTION DEVICE

T J MUELLER, R C NELSON, J T KEGELMAN, and R J ZEHEMNER (Notre Dame, University, IN) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p 45-48 refs

A new mechanism for introducing smoke into a wind tunnel which was devised to study forced and natural boundary layer transition around axisymmetric bodies is described. Previous devices had three fundamental shortcomings: pulsating action of the smoke, nonuniform smoke, and a temperature difference between the smoke and the air in the tunnel, which caused the smoke to rise. The new design uses a trombone bell device with a relatively large contraction ratio. The smoke entering the contraction cone passes through a honeycomb and enters the settling chamber. The resulting smoke stream is extremely uniform and free of pulsations. The smoke temperature is closer to the ambient temperature, significantly reducing the 'roll-up' problem.

C D

A85-47085

FLOW CONES FOR AIRPLANE FLIGHT TEST FLOW VISUALIZATION

J P CROWDER and P E ROBERTSON (Boeing Commercial Airplane Co., Seattle, WA) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p 60-64

Flow Cones, a newly developed improvement on the standard tuft method used in flight testing, are discussed. The shortcomings of the tuft method which Flow Cones were designed to overcome are reviewed, and Flow Cones are described. Several different applications of retroreflective Flow Cones are shown and described, including Flow Cones on an aircraft wing during a stall, air-to-air imaging using Flow Cones, and the detection of separation on the rotor surface of a wind turbine.

C D

A85-47090

USE OF TITANIUM TETRACHLORIDE FOR VISUALIZATION OF ACCELERATING FLOW AROUND AIRFOILS

P FREYMUTH, W BANK, and M PALMER (Colorado, University, Boulder) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p 99-105 refs

(Contract AF-AFOSR-81-0037)

The use of titanium tetrachloride for the visualization of airflows is described. Safety aspects and photographic techniques are considered. Examples of accelerating flow around an airfoil are shown exhibiting the complexity and beauty of unsteady flows.

Author

A85-47099

FLOW VISUALIZATION USING COMPUTER-GENERATED COLOR VIDEO DISPLAYS OF FLOW FIELD SURVEY DATA

A E WINKELMANN and C P TSAO (Maryland, University, College Park) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p 175-179

A computer driven color video display technique has been developed for the presentation of wind tunnel flow field survey data. The results of both qualitative and quantitative flow field surveys can be presented in high spatial resolution color coded displays. The display of data in this manner can be considered to be a new type of flow visualization. The technique enables one to present and interpret vast quantities of data which heretofore would have been difficult or impossible to comprehend. The technique has been used to display data obtained with a variety of wind tunnel type probe sensors, including hot-wire probes, pitot tubes, 5 and 7-tube pressure probes and a single channel laser velocimeter.

Author

A85-47106* Stanford Univ., Calif

THREE-DIMENSIONAL TOMOGRAPHIC RECONSTRUCTION OF THE FLOW AROUND A REVOLVING HELICOPTER ROTORBLADE - A NUMERICAL SIMULATION

L HESSELINK and R SNYDER (Stanford University, CA) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983. Washington, DC, Hemisphere Publishing Corp., 1985, p 213-220

(Contract NCC2-188)

This paper discusses tomographic data acquisition and reconstruction procedures for determining the flow around a revolving helicopter rotor blade. The data acquisition procedure is simulated using, as a testbed, a numerical representation of the flow and projections through this known field are computed. An investigation has been made of (1) the effect of the number of projections on the accuracy of the reconstruction and (2) the fidelity of the reconstruction when the region of intersection of all projections is smaller than the spatial extent of the flow.

Author

A85-47127

THE USE OF VISUALIZATION AS A GUIDE IN THE NUMERICAL DETERMINATION OF THE FLOW AROUND AN ABRUPTLY ACCELERATED ELLIPTIC CYLINDER OR AIRFOIL

P. MONNET, M. COUTANCEAU (Portiers, Université, France), O. DAUBE, and T. PHUOC LOC (CNRS, Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur, Orsay, France) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983 Washington, DC, Hemisphere Publishing Corp., 1985, p. 363-368

The time formation of the two-dimensional wake induced by an impulsively started thin profile is investigated both experimentally and numerically. The experimental technique is based on a precise visualization of the flow pattern with solid tracers from which quantitative data as well as qualitative information are deduced and used to improve the numerical simulation. This simulation is made by treating the Navier-Stokes equations with a high order compact finite difference scheme. The very good agreement exhibited by the results provided by the two methods makes it possible to give an accurate and detailed description of the evolution of the flow structure for both an elliptic cylinder and a NACA 0012 airfoil. These results are given for angles of attack ranging from 0 to 90 deg and for Reynolds numbers of 500, 1000, and 3000. Author

A85-47131

VORTEX FLOW VISUALIZATION STUDIES OF A STRAKE-WING IN WATER TUNNEL

B. ZHOU, M. LIU, S. XIONG, Z. LI, and W. SU (Beijing Institute of Aeronautics and Astronautics, People's Republic of China) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983 Washington, DC, Hemisphere Publishing Corp., 1985, p. 402-407 refs

Results of water-tunnel tests conducted on a strake-wing and a basic wing using a dye visualization technique are reported. The technique described here is shown to provide three-dimensional flow patterns of the leading edge vortex and its bursting. The results are analogous to those obtained in wind tunnel tests for a strake-wing with a sharp leading edge. The main flow patterns of the moderate sweptback cropped delta wing in the water tunnel tests can also be compared with the results of low-speed wind tunnel tests in the case where the wing leading edge is sharp. V L

A85-47150

DETERMINATION OF LEADING-EDGE VORTEX TRAJECTORIES BY SCHLIEREN PHOTOGRAPHY

J. ER-EL (Technion - Israel Institute of Technology, Haifa, Israel) IN Flow visualization III, Proceedings of the Third International Symposium, Ann Arbor, MI, September 6-9, 1983 Washington, DC, Hemisphere Publishing Corp., 1985, p. 676-680 refs

Flow on the leeside of a close-coupled canard-delta wing configuration is studied using the method of schlieren photography. The approach described here makes use of compressibility effects at the vortex core, which are a result of the subpressure generated by the azimuthal velocities, and of the increased axial velocities. These density changes, when sufficient, are detected by a schlieren system whose light rays are perpendicular to the vortex axis, while the knife-edge is parallel to it. Test results illustrating the effect of the canard sweep angle and longitudinal position on the leading-edge vortices and their breakdown characteristics are presented. V L

A85-47258#

A STUDY OF THE PHYSICAL MECHANISMS AND THE PERTURBATIONS CREATED BY THE ATTACHMENT OF AN ARC TO A CONDUCTING CYLINDER

P. LEVESQUE, J. TAILLET, G. LABAUNE, S. LARIGALDIE, and J. C. ALLIOT (ONERA, Chatillon-sous-Bagneux, France) (International Conference on Lightning and Static Electricity, Paris, France, June 10-12, 1985) ONERA, TP, no. 1985-47, 1985, 9 p. DRET-supported research refs (ONERA, TP NO 1985-47)

The typical phenomena related to voltage shock excitation of a suspended cylinder are analyzed in comparison with previous interpretations. The respective role, on the external electric field and on the internal voltage transients, of capacitive currents, streamers, leaders and arc transitions are emphasized. The rationale for voltage shock excitation aircraft testing is deduced from the conclusion of the study. Use of a medium-voltage fast rise-time Marx generator (300 kV, 50 ns) rather than a high voltage slow rise-time one (1.4 MV, 1 micron) is recommended. Author

A85-47273#

AN EXAMINATION OF TURBULENCE MODELS FOR A SEPARATING THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER

R. ABID, J. DELERY, and R. SCHMITT (ONERA, Chatillon-sous-Bagneux, France) (International Conference on Numerical Methods in Laminar and Turbulent Flows, 4th, University of Wales, Swansea, July 9-12, 1985) ONERA, TP, no. 1985-74, 1985, 13 p. refs (ONERA, TP NO 1985-74)

Turbulence modeling in separating 3-D boundary layers using an inverse method is discussed. The ability of models developed for 2-D flows to predict the separation of a 3-D boundary layer is examined, as is the influence of Rotta's (1977) hypothesis that the cause of the disagreement between calculative and experimental prediction of low speed flows with severe crossflow is an inadequate modeling of the pressure-strain correlation term of the Reynolds tensor transport equation. The validity of the considered models is tested by comparison with the well-known experiments of Van den Berg (1972) and Elsenaar (1974), which simulate an infinite swept wing situation. The boundary layer equations are solved by an inverse method with prescribed displacement thicknesses. C D

A85-47288#

CERAMIC HEAT EXCHANGERS FOR GAS TURBINES OR TURBOJETTS [INTERET DES ECHANGEURS EN CERAMIQUE POUR TURBINE A GAZ OU TURBOREACTEURS]

S. BOUDIGUES and J. FABRI (ONERA, Chatillon-sous-Bagneux, France) (NATO, AGARD, Symposium sur les Echanges Thermiques et Refroidissement dans les Moteurs a Turbines, 65th, Bergen, Norway, May 6-10, 1985) ONERA, TP, no. 1985-35, 1985, 14 p. In French (ONERA, TP NO 1985-35)

The required performance goals and several proposed designs for SiC heat exchangers for aerospace turbines are presented. Ceramic materials are explored as a means for achieving higher operating temperatures while controlling the weight and cost of the heat exchangers. Thermodynamic analyses and model tests by ONERA have demonstrated the efficacy of introducing a recirculation cycle and placing the heat exchangers between stages of the turbine. Sample applications are discussed for small general aviation aircraft and subsonic missiles equipped with single-flux exchangers. A double-flux exchanger is considered for an aircraft capable of Mach 0.8 speed and at least 11 km altitude for cruise. Finally, the results of initial attempts to manufacture SiC honeycomb heat exchangers are detailed. M S K

A85-47380

ULTRASONIC DETECTION OF CRACKS IN WEB GEOMETRIES
T A. GRAY and R B THOMPSON (DOE, Ames Laboratory, Ames, IA) IN Review of progress in quantitative nondestructive evaluation Volume 3A - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p. 47-56, Discussion, p 56 refs
(Contract W-7405-ENG-82)

A computer model is described which numerically simulates the crack detection process in order to identify system configurations which promise a high probability of crack detection. The experimental verification of the model's accuracy is shown using predictions for backscatter from cracks in a 0.635 cm thick diffusion-bonded IN100 plate. The use of the model in the design and optimization of ultrasonic detection systems for cracks in web geometries is illustrated. C D

A85-47381

ULTRASONIC MICROSTRUCTURAL NOISE PARAMETERS IN A POWDER METAL ALLOY

B R TITTMANN, L A AHLBERG, and K W FERTIG (Rockwell International Science Center, Thousand Oaks, CA) IN Review of progress in quantitative nondestructive evaluation Volume 3A - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p. 57-63, Discussion, p 63, 64 refs
(Contract W-7405-ENG-82)

The ultrasonic backscattering characteristics were measured for IN-100, a powder metallurgy alloy used for engine disk components. The data were obtained with a variety of different transducers placed either in a waterbath or in sample contact for a frequency range from 2 to 18 MHz and statistically averaged over numerous volume elements of the samples. Micrographical examination provided size and number distributions for grain and pore structure and showed that the predominant sources for backscatter were the larger micropores. Two samples with different micropore densities were used to demonstrate the feasibility of calculating microstructural parameters from the ultrasonic data.

Author

A85-47396

CRACK CHARACTERISATION IN TURBINE DISKS

L J BOND and N SAFFARI (University College, London, England) IN Review of progress in quantitative nondestructive evaluation Volume 3A - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p. 251-260, Discussion, p 261, 262 Research supported by the Ministry of Defence (Procurement Executive) refs

Nondestructive testing techniques which provide reliable quantitative defect characterization are of considerable importance for a full utilization of fracture mechanics approaches and the application of Retirement-for-Cause (RFC) concepts to critical aerospace components. In the present paper, ultrasonic techniques are presented which have been developed for the detection and characterization of small surface defects in aircraft engine turbine disks. These techniques are based on a utilization of the reflection of surface waves and the phenomena of body-to-surface mode-conversion found at surface breaking and near surface defects for features in the range from 0.05 to 1.0 mm. Possibilities concerning a crack characterization on the basis of the results obtained with the considered techniques are examined, taking into account the midfrequency regime where the defect depth is comparable to or just smaller than the wavelengths involved.

G R.

A85-47402

DEVELOPMENT OF A QUANTITATIVE FLAW CHARACTERIZATION MODULE - A STATUS REPORT

G J GRUBER, G J HENDRIX, and T A MUELLER (Southwest Research Institute, San Antonio, TX) IN Review of progress in quantitative nondestructive evaluation Volume 3A - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p. 309-320, Discussion, p 320, 321 refs
(Contract F33615-81-C-5066)

It is pointed out that life-management technology now being developed for the Air Force under the name 'retirement for cause' requires reliable and accurate ultrasonic techniques for characterizing internal bulk flaws in titanium- and nickel-based alloy disk materials. The present paper is concerned with the utilization of quantitative nondestructive evaluation techniques based on the interaction of ultrasound with internal bulk flaws. A flow diagram of the program established to qualify the Born inversion technique for sizing voids and inclusions in typical aircraft turbine-engine parts is considered. Ultrasound-flaw interaction models are discussed, taking into account the Born model for spherical inclusions, and the Franz-Gruber model for spherical voids. An algorithm performance evaluation is also conducted, giving attention to shear-wave measurements, and longitudinal-wave measurements. G R

A85-47428

LABORATORY STUDIES RELATED TO IN-FLIGHT ACOUSTIC EMISSION MONITORING

S R LAMB (Department of Defence, Aeronautical Research Laboratories, Melbourne, Australia) IN Review of progress in quantitative nondestructive evaluation Volume 3B - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p. 729-734

Laboratory tests undertaken to identify the source of acoustic emission (AE) detected in flight on the MACCHI aircraft are reported, and the results obtained using different equipment are compared. The test component was subjected to repeated application of a spectrum of loads representative of the previous flight history, simulating a sequence of 200 flights. A significant difference in the rates of AE counts with increasing crack length between in-flight tests and laboratory tests is found and discussed. C D

A85-47469

MANUFACTURING TECHNOLOGY FOR NONDESTRUCTIVE EVALUATION (NDE) SYSTEM TO IMPLEMENT RETIREMENT FOR CAUSE (RFC) PROCEDURES FOR GAS TURBINE ENGINE COMPONENTS

F M TAYLOR, D L BIRX, and D G DOOLIN (Systems Research Laboratories, Inc., Dayton, OH) IN Review of progress in quantitative nondestructive evaluation Volume 3B - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p. 1331-1335, Discussion, p 1335-1337

An automated NDE inspection system capable of detecting 5 x 10 mil surface flaws and 15 mil inclusions in engine rotor components is being developed. This system represents an aid for the implementation of the 'Retirement for Cause' (RFC) philosophy according to which the large percentage of good, used engine rotor components are returned to service, and the small percentage of flawed components are retired for cause. Particular attention is given to the detection and characterization of critical flaws through a utilization of computer algorithms. It is pointed out that the Inspection Module's NDE instrumentation represents the most advanced computer-controlled ultrasonic and eddy current instrumentation available. G R

A85-47470**NDT-33 - A COMPUTERIZED EDDY CURRENT INSTRUMENT**

R C BODMER, C L FREDERICK, L L LANG, and J J PICKERD (NORTEC Corp., Kennewick, WA) IN Review of progress in quantitative nondestructive evaluation Volume 3B - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p 1339-1346, Discussion, p 1346, 1347

In connection with the Air Force 'Retirement for Cause' Program, a high-speed computer-controlled multifrequency digital eddy current inspection instrument is being developed for automated aircraft engine disk inspection. The instrument is primarily digital and completely controlled by software for automatic computerized disk inspection. The use of new high-speed microprocessors allows fast scanning and processing of data for an automatic inspection system. The digital signal processing makes the unit versatile for many other inspections using manual or computer operation. Attention is given to a system diagram, system operation, the controller, the display, the oscillator, the detector and converter, the digital signal processor, the proximity probe, and the scanner drive electronics. G R

A85-47472**INNOVATIVE EDDY CURRENT PROBE COUPLING METHOD**

G M LIGHT, W R VAN DER VEER, W D PERRY, and G L BURKHARDT (Southwest Research Institute, San Antonio, TX) IN Review of progress in quantitative nondestructive evaluation Volume 3B - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p 1359-1366, Discussion, p 1367, 1368

A design of an air-bearing eddy current probe, for use in the Retirement for Cause/Nondestructive Examination (RFC/NDE) program, to examine aircraft engine parts is presented. The air-bearing acts like a spring which interacts with the probe suspension spring in order to achieve equilibrium at a certain liftoff. The probe is to follow the surface of the suspension, while holding the thickness of the air-film constant, as the total distance from the probe surface to the suspension mount changes. For optimum stability and accuracy the stiffness of the air-bearing must be greater than the stiffness of the suspension, stiffness is determined by the surface area and air flow. The air-bearing eddy current probe was designed and tested for static and dynamic cases. In all cases, the stability of the air-bearing thickness was approximately ± 0.0001 inch with an average liftoff of 0.0007 inch. I F

A85-47473**DEVELOPMENT OF ACTIVE MICROWAVE FERROMAGNETIC RESONANCE EDDY CURRENT PROBES AND ASSOCIATED SIGNAL PROCESSING METHODS**

J M PRINCE (Battelle Pacific Northwest Laboratories, Richland, WA) and B A AULD (Stanford University, CA) IN Review of progress in quantitative nondestructive evaluation Volume 3B - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p 1369-1376 (Contract F33615-82-C-5100)

A number of theoretical and experimental studies have been conducted with YIG (Yttrium Iron Garnet)-based FRM (ferromagnetic resonance) eddy current probes. A primary goal of this research was to develop a method of discriminating between liftoff and flaw signals. The present investigation has an additional aim which is related to the development and demonstration of a practical FMR-based flaw detection system for aircraft turbine engine component inspection. In order to overcome certain difficulties, it was decided to utilize the FMR probe in an active mode in which it operates as the resonant element of a microwave oscillator circuit (active FMR probe) at frequencies in the range from 600 to 1100 MHz. The experimental results presented in this paper demonstrate that two-parameter discrimination of flaw data from liftoff noise is realizable with a single active FMR probe and associated processing electronics. G R

A85-47474**ELECTRIC CURRENT PERTURBATION INSPECTION OF SELECTED RETIREMENT-FOR-CAUSE TURBINE ENGINE COMPONENTS**

G L BURKHARDT, F N KUSENBERGER, and R E BEISSNER (Southwest Research Institute, San Antonio, TX) IN Review of progress in quantitative nondestructive evaluation Volume 3B - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p 1377-1386, Discussion, p 1387 USAF-supported research

The Electric Current Perturbation (ECP) automated inspection system is currently undergoing optimization for the inspection of typical F100 turbofan engine component features, such as antirotation windows and blade slots. A computer-controlled laboratory breadboard ECP system has been fabricated for the scanning of these complex features. While ECP evaluations were initially performed on simple geometry specimens in order to demonstrate the method's sensitivity, preliminary results have recently been obtained on antirotation windows in the F100 engine 2nd-3rd fan stage seal, as well as on blade slots in the first stage fan disk. O C

A85-47475**EVALUATION OF CAPTURED WATER COLUMN TECHNOLOGY FOR ADVANCED ULTRASONIC SIZING TECHNIQUES**

G M LIGHT, R A CERVANTES, and W R VAN DER VEER (Southwest Research Institute, San Antonio, TX) IN Review of progress in quantitative nondestructive evaluation Volume 3B - Proceedings of the Tenth Annual Review, Santa Cruz, CA, August 7-12, 1983 New York, Plenum Press, 1984, p 1389-1396, Discussion, p 1397, 1398

A fighter engine inspection system combining both ultrasonic and eddy current has been developed for the Air Force in connection with the Retirement For Cause/Nondestructive Examination (RFC/NDE) program. The design and testing of several captured water columns in the RFC/NDE system is discussed in comparison with conventional immersion-mode time-amplitude signal measurements and Born inversion techniques. The patented design features of the system include a water guide to give even distribution of the two inlet water streams, a water focus extension collar to concentrate water flow at the lens of the transducer, and an extension collar to increase the range of focal distances. It is shown that the water column system did not degrade the quality of the reflected ultrasonic pulses in measurements of flaw size range. I H

A85-47849**PREDICTION OF THE INCEPTION OF CAVITATION ON BLADE PROFILES OF HYDRAULIC TURBOMACHINES [VORAUSSAGE DES KAVITATIONSBEGINNS AN SCHAUFELPROFILIEN HYDRAULISCHER TURBOMASCHINEN]**

J STELLER (Polska Akademia Nauk, Instytut Maszyn Przeplywowych, Gdansk, Poland) Forschung im Ingenieurwesen (ISSN 0015-7899), vol 51, July 1985, p 123-131. In German refs

A number of methods for the calculation of the velocity distribution on blade profiles have been developed after Scholz (1965) provided his presentation of the aerodynamics of cascades. The computational procedures discussed by Jacob (1963, 1969, 1976, 1981) deserve particular attention. It has also been possible to observe certain relations between cavitation inception and phenomena in the boundary layer. The concepts employed by Jacob are based on the theory of harmonic vector fields and the theoretical results reported by Martensen and von Sengbusch (1960). In the present study an approach is shown for utilizing Jacob's concepts for selected periodic profile configurations. Particular attention is given to the flow through a straight cascade and the flow around a wing located between parallel walls. A suitable FORTRAN program for the calculation of the flow between parallel walls has been developed by Steller (1983). The prediction of cavitation inception is illustrated with the aid of two examples involving NACA foils. G R

A85-48084

ACOUSTIC EMISSION MONITORING OF FLAW GROWTH IN A GRAPHITE-EPOXY EXPERIMENTAL WING SEGMENT

J RODGERS (Acoustic Emission Technology Corp., Sacramento, CA) Journal of Acoustic Emission (ISSN 0730-0050), vol 4, January-March 1985, p 1-8 refs

Acoustic emission (AE) monitoring of flaw growth was performed on a composite wing segment. An 8-channel AE system with a microcomputer to acquire and process AE data was used to monitor a graphite-epoxy upper wing segment during load testing. A tension limit load cycle was conducted, then the wing was loaded in compression to limit load, where it failed after 30 sec by buckling along the inboard flange. At low load levels the AE data revealed damage in the outboard flange. The low frequency ratio signaled the onset of creep instability. The results corresponded well to previous tests. It is concluded that AE monitoring could provide great assistance in early assessment of fiber composite materials. IF

A85-48220

COMPUTATIONAL METHODS FOR DISCONTINUITIES IN FLUIDS

O A MCBRYAN (New York University, NY) IN Large-scale computations in fluid mechanics, Proceedings of the Fifteenth Summer Seminar on Applied Mathematics, La Jolla, CA, June 27-July 8, 1983 Part 2 Providence, RI, American Mathematical Society, 1985, p 63-79 refs
(Contract DE-AC02-78ER-03077, NSF DMS-83-12229)

In the present paper, a description is provided of a range of computational methods for fluid flows in which shocks or discontinuities occur. Collectively, these methods constitute the method of front tracking. Front tracking refers to certain computational methods in which special degrees of freedom are placed at fronts or discontinuities in order to obtain increased resolution in those areas. In shock tracking, an extra lower-dimensional grid is introduced, geometrically fitting the shocks. Attention is given to discontinuities in fluid physics, numerical computations, shock tracking methods, current applications of tracking, efficient elliptic solution methods, finite element and discontinuities, high-order solutions by ADI (Alternating Direction Implicit) preconditioning, multigrid solutions, and interfaces and discontinuities. GR

A85-48224

SOME CONTRIBUTIONS TO THE MODELLING OF DISCONTINUOUS FLOWS

P L ROE (Royal Aircraft Establishment, Bedford, England) IN Large-scale computations in fluid mechanics, Proceedings of the Fifteenth Summer Seminar on Applied Mathematics, La Jolla, CA, June 27-July 8, 1983 Part 2 Providence, RI, American Mathematical Society, 1985, p. 163-193 refs

Roe (1980) advanced the claim that 'almost any' good numerical technique for solving the linear scalar wave equation could be converted, by a fairly simple mechanism, into an equally good numerical technique for solving quasi-linear systems of conservation laws. It is pointed out that the particular attraction of that mechanism lay in its ability to generalize the class of asymmetric, or 'upwinded' finite-difference schemes, in a simple and natural way. In the present investigation, Roe's claim is reviewed and revised in the light of two and a half years of additional experience. A fairly general form of the flux difference splitting concept, applicable to one-dimensional conservation laws, is discussed. Attention is given to the 'monotone' second-order scheme, the designing of the B-functions, and problems regarding satisfying entropy. GR

A85-48521* National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif.

DIGITAL FRINGE REDUCTION TECHNIQUES APPLIED TO THE MEASUREMENT OF THREE-DIMENSIONAL TRANSONIC FLOW FIELDS

F BECKER and Y H YU (NASA, Ames Research Center, Moffett Field, CA) Optical Engineering (ISSN 0091-3286), vol 24, May-June 1985, p 429-434 refs

A system for digital interferogram evaluation based on an image-processing system connected to a host computer has been implemented. The system supports one- and two-dimensional interferogram evaluations. Interferograms are digitized, enhanced, and segmented. The fringe coordinates are extracted, and the fringes are represented as polygon data structures. Fringe numbering and fringe interpolation modules are implemented. The system supports editing and interactive features as well as graphic visualization. An application of the system to the evaluation of double exposure interferograms from the transonic flow field around a helicopter blade and the reconstruction of the 3-D flow field are given. Author

A85-48557#

THE ROLE OF DAMPING ON SUPERSONIC PANEL FLUTTER

I LOTTATI (Technion - Israel Institute of Technology, Haifa) AIAA Journal (ISSN 0001-1452), vol 23, Oct 1985, p 1640-1642 refs

Attention is given to the effects of viscoelastic damping on the instability of a plate in supersonic flow, including those aspects of damping which involve coupling with midplane forces or external damping. The panel in question is a flat, simply supported one-dimensional beam that is subjected to supersonic flow over one of its sides. OC

A85-48853

NEW AWOS PROVIDES SYNTHESIZED-VOICE WEATHER INFORMATION

A GREENBERG, J STERN, and W HACKENBERG (General Signal Corp., Cardion Electronics Div., Woodbury, NY) ICAO Bulletin, vol 40, April 1985, p 16-19

A complete Automated Weather Observation System (AWOS) that measures wind direction and speed, wind gusts, temperature, dew point, precipitation, visibility, cloud height and cover, altimeter setting, and density altitude is described. AWOS averages the continuously measured weather parameters, converting them into a synthesized-voice output that can modulate a VHF transmitter or navais voice channel for transmission directly to a pilot in flight. Remote access to the weather message is achieved by a telephone coupler, while a modem allows access to the recorded digital weather data. A newer version of AWOS comprised of four interaction systems, the weather reporting station (data collection and dissemination), two remote sensing facilities, the center-field site and the runway site, and the weather message transmission capability, is also described in detail. IS

A85-48992

NUMERICAL SIMULATIONS OF VISCOUS FLUID FLOWS IN AIR INTAKES AT HIGH ANGLES OF ATTACK [SIMULATIONS NUMERIQUES D'ECOLEMENTS DE FLUIDES VISQUEUX DANS LES ENTREES D'AIR A GRANDE INCIDENCE]

C BEGUE, B MANTEL, J PERIAUX (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, France), M O BRISTEAU (Institut National de Recherche en Informatique et Automatique, Rocquencourt, France), and R GLOWINSKI (Paris VI, Université, France) Association Aeronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 21st, Ecully, France, Nov 7-9, 1984 43 p In French refs
(Contract DRET-80-321, DRET-83-403)
(AAAF PAPER NT 84-12)

Techniques are presented for finite element solution of the Navier-Stokes equations (NSE) for steady and unsteady flows of incompressible and compressible viscous fluid flows. A time-step discretization is performed in Hilbert space by means of a decomposition of operators. Two schemes are described for the

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decomposition, and applications with the NSE are developed to illustrate methods of separating the incompressibility and nonlinearity of the NSE. The models are extended to the case of compressible fluids, and results are provided from several two- and three-dimensional calculations for the flow into a jet engine intake duct at high angles of attack. M S K

A85-49100

AEROSPACE RADIOGRAPHY - THE LAST THREE DECADES

D J HAGEMAIER (Douglas Aircraft Co., Long Beach, CA) *Materials Evaluation* (ISSN 0025-5327), vol 43, Sept 1985, p 1262-1264, 1266, 1268 (12 ff) refs

The developments in industrial radiography over the period 1955-1985 are reviewed with particular reference to aerospace applications. Topics discussed include in-motion radiography of weldments, radiography of honeycomb structures, helicopter composite rotor/propeller blades, and solid-propellant rocket motors, and jet engine gamma-ray inspection. The discussion also covers cinefluorography and X-ray image intensifier tests, neutron-radiography of special aerospace components, microfocus radiography, and advanced computer tomography. Finally, the use of advanced industrial X-ray technology in the Space Shuttle project is examined. V L

A85-49346

RADAR TARGETS REVEAL ALL TO AUTOMATED TESTER

R E HARTMAN (Flam and Russell, Inc., Horsham, PA) *Microwaves & RF* (ISSN 0745-2993), vol 24, Sept 1985, p 101, 102, 104, 106, 107

Technological developments in the field of automated test equipment for low radar-cross-section (RCS) systems are reviewed. Emphasis is given to an Automated Digital Analysis and Measurement (ADAM) system for measuring, scattering, and evaluating RCS using a minicomputer in combination with a vector network analyzer and a positioner programmer. ADAM incorporates a stepped CW measurement technique to obtain RCS as a function of both range and frequency at a fixed aspect angle. The operating characteristics and calibration procedures of the ADAM system are described and estimates of RCS sensitivity are obtained. The response resolution of the ADAM system is estimated to be 36 cm per measurement bandwidth (in GHz) for a minimum window. A block diagram of the error checking routine of the ADAM system is provided. I H

A85-49351

EFFECTS CAUSED BY SMALL DISCRETE TWO-DIMENSIONAL ROUGHNESS ELEMENTS IMMERSSED IN TURBULENT BOUNDARY LAYERS

H H NIGIM (Birzeit University, Jordan) and D J COCKRELL (Leicester, University, England) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol 153, April 1985, p 17-30 refs

In order to determine the downstream consequences of the presence of small discrete surface discontinuities situated on otherwise smooth surfaces and subjected to six equilibrium two-dimensional adverse-pressure-gradient turbulent boundary-layer flows, these conditions were first established in a special purpose wind tunnel. A surface discontinuity is small if it lies within the logarithmic region of the undisturbed boundary layer. Immediately downstream of such discontinuities flow separation ensues. After the subsequent reattachment, measurements were made of the downstream boundary-layer development. Even in strong adverse pressure gradients the local increments of momentum thickness caused by these roughness elements were well predicted by Gaudet and Johnson's (1970) zero-pressure-gradient correlation. With highly adverse pressure gradients it was found that these small surface discontinuities have little influence on the flow downstream. The essential outcome of this work is that the incremental drag of small roughness elements depends solely on local wall variables. Thus, when the pressure gradient is strongly adverse and the local skin friction is correspondingly small, the incremental drag of the roughness element becomes similarly small. After reattachment, it has an insignificant effect on the flow downstream of it. Author

A85-49359

TEMPERATURE FLUCTUATIONS AND HEAT FLUX IN GRID-GENERATED ISOTROPIC TURBULENCE WITH STREAMWISE AND TRANSVERSE MEAN-TEMPERATURE GRADIENTS

R BUDWIG, S CORRSIN (Johns Hopkins University, Baltimore, MD), and S TAVOULARIS (Ottawa, University, Canada) *Journal of Fluid Mechanics* (ISSN 0022-1120), vol 153, April 1985, p 441-460 NSF-supported research refs

A screen of closely spaced, parallel, thin wires was placed downstream of a grid generating nearly isotropic turbulence. The screen was normal to the flow and was heated in one of two modes: (1) periodically in time, to generate a train of transversely uniform streamwise thermal ramps, each with a uniform streamwise gradient, and (2) steadily, with transverse non-uniformity, to generate a uniform transverse thermal ramp. The simple temperature and temperature-gradient fluctuation statistical properties in both cases were found to be comparable to those encountered in earlier works with a steadily heated grid producing a uniform transverse thermal ramp. In both modes of heating the temperature fluctuations decreased initially behind the screen and then increased monotonically. The turbulent heat-transfer correlation coefficient attained an asymptotic magnitude between 0.7 and 0.8 for both modes of heating. The skewness of the temperature fluctuation derivative in the direction of the mean gradient was found to be non-zero despite the absence of mean shear. Author

A85-49526

ANNUAL RELIABILITY AND MAINTAINABILITY SYMPOSIUM, SAN FRANCISCO, CA, JANUARY 24-26, 1984, PROCEEDINGS

Symposium sponsored by IEEE, AIAA, ASME, et al. New York, IEEE, 1984, 576 p. For individual items see A85-49527 to A85-49589.

The present conference addresses topics in computer-aided reliability and maintainability, mechanical reliability, the management of reliability and maintainability (R&M), the status of the U.S. Department of Defense/industry R&M study, reliability assessment, testing, and screening, testability and automatic testing, dormant reliability, the use of R&M field data, software reliability, built-in testing (BIT), modeling and simulation methods, robotics and automation, operational readiness, reliability growth, and maintainability. Specific attention is given to electronic equipment thermal management, MTBF predictions, BIT self-verification, expert systems in software maintainability, spacecraft anomalies and lifetimes, fiber-optics reliability, and lower limits for total ship reliability. O C

A85-49530#

ELECTRONIC EQUIPMENT THERMAL MANAGEMENT

R L BERGER and L C JENKINS (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN *Annual Reliability and Maintainability Symposium*, San Francisco, CA, January 24-26, 1984, Proceedings. New York, IEEE, 1984, p 17-22.

An assessment is made of the importance of thermal management in electronic equipment design, illustrating the ways in which CAD technology may be used to improve electronic equipment thermal management programs. Attention is given to the Electronic Equipment Thermal Management portion of the aircraft system-level Thermal Management Control (TMC) program. TMC establishes the process by which the airframe's environmental control system and the electronic equipment are integrated to optimize system reliability through life cycle cost minimization, by allocating available cooling capacity to system elements on the basis of derived benefits. O C

A85-49536

MAINTAINABILITY ASPECTS IN MAINTENANCE MANAGEMENT

W R DOWNS (Wm Downs Technical/Management Services, Rancho Palos Verdes, CA) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 62-66 refs

This paper discusses the need for the operator of equipment to continue the efforts of the manufacturer in the user environment in order to assure the maintainability performance potential built into the system. The maintainability performance predicted for the system is usually based on an operations model that is assumed to be real but may differ in many ways from the actual operations environment. Downtime, availability, and maintenance manhours, the common maintainability performance criteria, can vary widely as a function of maintenance concepts and maintenance planning to control those elements that are crucial to the attainment of maintainability performance objectives. Data relating to operations are presented in regard to the maintainability performance parameters they affect, and analyses are presented as examples of the types of analyses system operators may perform in order to optimize maintainability performance in the field. Author

A85-49538

DOD/INDUSTRY - R&M TECHNOLOGY STUDY ANALYSIS

H B LYON, JR (Texas Instruments, Inc, Arlington, VA) and K P LASALA (U.S. Navy, Naval Materiel Command, Arlington, VA) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 99-102

Attention is given to the Technology Study portion of the Institute for Defense Analyses' Reliability and Maintainability (R&M) study, which focused on processes for the derivation of technology requirements, the identification of 'ripple effects' associated with novel technologies' introduction and mutual interaction, and an approach to the 'off-line' maturation of technologies. The R&M study has uniquely constituted a comprehensive joint government/industry review of important emerging technologies. O C

A85-49539#

ESTABLISHING REALISTIC REQUIREMENTS FOR RELIABILITY, MAINTAINABILITY, AND BUILT-IN-TEST

R C TRAKAS (U.S. Navy, Naval Air Systems Command, Washington, DC) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 103-107

Steps have been taken within the Naval Air Systems Command to provide a repeatable, logical approach to establishing realistic requirements for reliability, maintainability, and built-in-test (BIT). This approach prevents problems on programs under development where failure to meet specified requirements in the areas of reliability, maintainability, and BIT could be attributed to establishment of arbitrary, unrealistic requirements with little or no basis in fact. The approach taken ensures the proper relationship between the program thresholds within the Navy and the contractually specified requirements. This provides for a cost-effective and realistic method for ensuring that adequate inherent reliability, maintainability, and BIT capabilities are designed into the equipment to meet the stated operational requirements. Author

A85-49541

A MANAGEMENT GUIDE TO RELIABILITY PREDICTIONS

F A STOVALL (Lockheed-Georgia Co, Marietta, GA) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 114-116

Although reasonably accurate reliability predictions are obtainable through the procedure contained in military standard MIL-HDBK-217, if enough is known about operational environment, equipment design, vendor manufacturing capability, and delivery schedule, a less costly procedure may sometimes be required for

the assessment of vendor-claimed reliability levels or the estimation of probable equipment reliability level. Attention is presently given to a simplified prediction chart which, while not as accurate as MIL-HDBK-217, may nevertheless be useful in the preliminary determination of probable need for part screening, thermal imaging, reliability growth tests, etc. O C

A85-49581

AN M PRINCIPLE - PAY ME NOW OR SPEND MORE LATER

W B DALRYMPLE (Boeing Aerospace Co, Seattle, WA) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 493-498 refs

The basic principles of a good maintainability (M) program are presented with reference to the reduction of aircraft and aircraft weapons system development costs. Common boundaries between M and interfacing functions are discussed. Particular attention is given to fault isolation, mathematical modeling, maintenance manhours improvements, and mockups. It is concluded that integration is the key element in keeping the cost of M reasonable. B J

A85-49586

A SYSTEMATIC APPROACH TO DESIGNING FOR TESTABILITY

R JAGER (Westinghouse Electric Corp, Baltimore, MD) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 520-524

The purpose of this paper is to describe a systematic, formalized, and timely approach to designing avionics for testability at all maintenance levels, which will reduce many of the current problems in the field, such as 'RETEST OKs' and 'CANNOT DUPLICATES'. The approach was developed to be used by avionics designers, and is recommended for program office personnel who specify requirements for avionics design. It was developed to provide a high level of testability to meet specified standards and to maximize the compatibility of the avionics with its support equipment. The objective of this approach to testability in design is to maximize the availability of the avionics system and minimize repair time, spares, and logistics support requirements. Key features of this paper are the systematic approach to designing for all maintenance levels and an integrated maintenance concept which will allow compatible system support, even if separate contractors perform the support at different maintenance levels. Author

A85-49588

R&M ANALYSIS TECHNIQUES FOR FAULT-TOLERANT SYSTEMS

M H VEATCH, A B CALVO (Analytic Sciences Corp, Reading, MA), and J L MCMANUS (USAF, Logistics and Human Factors Div, Wright-Patterson AFB, OH) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 530-536 refs

Reliability and logistics support analysis techniques for fault-tolerant avionics systems are presented. The systems considered contain integration and dynamic reconfigurability as part of their fault-tolerant design. These characteristics, combined with the need for analysis during the early stages of development, pose unique modeling requirements. The techniques developed address this need by providing design criteria based on reliability and maintainability during the early stages of design. They are applicable to the Integrated Communication, Navigation and Identification Avionics (ICNIA) architectures which are currently entering the advanced development phase. Author

A85-49704#

VARIATIONAL PRINCIPLE FOR TWO DIMENSIONAL FLOWS OF THE COMPRESSIBLE IDEAL FLUID WITH INCONTINUOUS SURFACES

M SU (Qinghua University, Beijing, People's Republic of China) Acta Aerodynamica Sinica, no 3, 1985, p 34-44. In Chinese, with abstract in English. refs

A85-50063#

BONDED REPAIR OF DAMAGE

R JONES (Defence Science and Technology Organization, Aeronautical Research Laboratories, Melbourne, Australia) Aeronautical Society of India, Journal (ISSN 0001-9267), vol 36, Aug 1984, p 193-201 refs

Two approaches developed for the analysis and design of repairs of damaged metallic structures by use of fiber-reinforced patches are presented. The finite element approach, discussed along with the formulation of the finite element and derivation of the element stiffness matrix, is illustrated by considering the repair of cracks in the lower wing skin of a Mirage III aircraft. An analytical approach is used in the repair design of a center-notched thin sheet, and is presented along with an approximate closed-form solution. The structural design considerations are emphasized and are illustrated by considering the design of several recent aircraft repair schemes. I S

A85-50065#

RECENT ADVANCES IN FATIGUE CRACK GROWTH PREDICTIONS

G MARCI (DFVLR, Institut fuer Werkstoff-Forschung, Cologne, West Germany) Aeronautical Society of India, Journal (ISSN 0001-9267), vol 36, Aug 1984, p 237-254 refs

The capability of accurate fatigue crack growth (FCG) life prediction is essential for optimizing the structural safety and economic operation of modern aircraft. FCG prediction schemes which compute the crack growth rate cycle by cycle and are based on the effective stress intensity concept of Elber (1971) are examined. The basic FCG-rate equations relevant to the Elber model are reviewed, and it is shown that the relatively simple exponential FCG-rate equations have to be modified to accommodate the observed FCG behavior. Procedures for determining the stress intensity factor at which a fatigue crack opens are then discussed as are some characteristics of the crack growth behavior implied by Newman's approach (1981). It is pointed out that more experimental work is required to refine the modeling of compressive loading in fatigue. V L

A85-50108

MANUFACTURE OF COMPOSITE PROPELLER BLADES FOR COMMUTER AIRCRAFT

R MCCARTHY (Dowty Rotol, Ltd, Gloucester, England) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 11 p (SAE PAPER 850875)

A manufacturing method employing a resin injection process which yields good fiber volume fractions, and correspondingly high structural strength, has been developed for the composite propeller blades that will be used by next-generation turboprop commuter aircraft. NDT and quality control methods are incorporated into this manufacturing process to ensure high quality, as corroborated by a certification procedure for propellers of this new type that encompassed both structural and environmental stresses. The environmental tests include lightning strike and bird strike effects. Flight testing has been conducted with Saab-Fairchild 340, Cheyenne IV, and Fokker 50 twin turboprop aircraft. O C

A85-50113

AGE FORMING TECHNOLOGY EXPANDED IN AN AUTOCLAVE

D M HAMBRICK (Avco Corp, Avco Aerostructure Div, Nashville, TN) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 18 p (SAE PAPER 850885)

Development of the autoclave forming aluminum (AFA) process has advanced current technology of age forming. Using an autoclave for application of aging heat and forming pressure, the process has been used to form 50 feet long, 2124 and 2419 aluminum wing skins containing integrally machined stiffeners and varying in thickness from 0.1 to 2.5 inches with thick pads in the middle of thin sections. The process produces smooth contours with no visible evidence of abrupt changes in thickness. The skins

are believed to be the largest and most complex parts ever to be age creep formed in the history of the aircraft industry. Author

N85-34312# Cranfield Inst of Tech, Bedford (England) Coll of Aeronautics

SOME PROBLEMS IN HIGH SPEED GEARS AND GEARING

J H WEBB In its Proc of the Mech Conf, Vol 1 10 p 1984 refs 2 Vol Avail NTIS HC A07/MF A01

Some of the causes of noise in high speed gears are considered. Analytical approaches aimed at the prediction and reduction of noise levels, and work conducted on these matters are discussed. Much of the work is taken from helicopter research, however the methods described are relevant to the process and other industries. E A K

N85-34326# Department of Energy, Washington, D C

COMBINED COLD COMPRESSOR/EJECTOR HELIUM REFRIGERATOR Patent Application

D P BROWN, inventor (to DOE) 5 Jun 1984 18 p (Contract DE-AC02-76CH-00016) (DE85-006408, US-PATENT-APPL-SN-617656) Avail NTIS HC A02/MF A01

A refrigeration apparatus having an ejector operatively connected with a cold compressor to form a two stage pumping system is described. This pumping system is used to lower the pressure, and thereby the temperature of a bath of boiling refrigerant (helium). The apparatus as thus arranged and operated has substantially improved operating efficiency when compared to other processes or arrangements for achieving a similar low pressure. DOE

N85-34354*# Syracuse Univ, N Y Dept of Mechanical and Aerospace Engineering

UNSTEADY TRANSONIC HEAT TRANSFER IN A TRANSIENT FACILITY Semiannual Progress Report

J E LAGRAFF 1 Sep 1985 8 p (Contract NAG3-621) (NASA-CR-176145, NAS 1 26 176145) Avail NTIS HC A02/MF A01 CSCL 20D

A facility for making heat transfer measurements on solid surfaces using transient techniques is constructed. The facility being constructed is a Ludwig tube with isentropic compression heating (LICH tube). The work completed is detailed as is the work remaining in order to complete the facility and make useful heat transfer measurements. The scope of the project is briefly discussed along with an overall appraisal of the progress. Author

N85-34355*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

NOZZLE WALL ROUGHNESS EFFECTS ON FREE-STREAM NOISE AND TRANSITION IN THE PILOT LOW-DISTURBANCE TUNNEL

T R CREEL, JR, I E BECKWITH, and F J CHEN (High Technology Corp) Sep 1985 34 p refs Original contains color illustrations (NASA-TM-86389, L-15903, NAS 1 15 86389) Avail NTIS HC A03/MF A01 CSCL 20D

An investigation at Mach 3.5 into the effects of nozzle wall roughness on free stream pressure fluctuations and cone transition Reynolds numbers was conducted in the pilot low disturbance tunnel at the Langley Research Center. Nozzle wall roughness caused by either particle deposits or imperfections in surface finish increased free stream noise levels and reduced the transition Reynolds numbers on a cone mounted in the test rhombus. Author

N85-34378*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif
PRACTICAL ASPECTS OF LASER HOLOGRAPHIC INTERFEROMETRY IN WIND TUNNELS
J LICURSI and G LEE Sep 1985 13 p refs
(NASA-TM-86788, REPT-85365, NAS 1 15 86788) Avail NTIS
HC A02/MF A01 CSCL 14B

Practical aspects of using laser holographic interferometry in some NASA Ames wind tunnels are presented. These aspects include the development of techniques for dual-plate interferometry, optics alignment, and laser alignment. In addition, methods to alleviate problems associated with vibration, photographic processing, photographic drying, and photographic reconstruction are discussed. Author

N85-34402* National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
OXIDIZING SEAL FOR A TURBINE TIP GAS PATH Patent
J D CAWLEY, inventor (to NASA) 10 Sep 1985 7 p Filed
19 Apr 1984 Supersedes N84-22935 (22 - 13, p 1993)
(NASA-CASE-LEW-14053-1, US-PATENT-4,540,336,
US-PATENT-APPL-SN-602050, US-PATENT-CLASS-415-174,
US-PATENT-CLASS-415-170-R, US-PATENT-CLASS-415-196,
US-PATENT-CLASS-415-200, US-PATENT-CLASS-416-174)
Avail US Patent and Trademark Office CSCL 11A

The sealing of the gas path in a gas turbine engine at the blade tips is improved by maintaining a minimum clearance between the rotor blade tips and the gas path seal. This is accomplished by taking advantage of an increase in volume during controlled oxidation of certain intermetallic compounds which have high melting points. The increase in volume closes the clearance subsequent to a rub between the blades and the seal. Thus, these compounds re-form the tip seal surface to assure continued engine efficiency.

Official Gazette of the U S Patent and Trademark Office

N85-34421# Rolls-Royce Ltd, Derby (England) Product
Assurance Supply Group
TOWARDS THE YEAR 2000: DEVELOPMENTS IN INSPECTION AND PRODUCT ASSURANCE TO BE ANTICIPATED DURING THE NEXT 15 YEARS

T BROUGHTON and A J S PRATT 7 Feb 1985 8 p
Proposed for presentation at Assoc Aeron et Astronautique de France and Assoc Franc pour le Controle et la Qualite
(PNR-90258) Avail NTIS HC A02/MF A01

Trends in aircraft engine inspection technology, including dimensional inspection, visual inspection, and nondestructive testing, including ultrasonics, X-rays, surface integrity, and functional testing are discussed. The role of the computer, and the Rolls-Royce product assurance philosophy are outlined. Author (ESA)

N85-35365 Arizona State Univ, Tempe
HEAT TRANSFER CHARACTERISTICS FOR TWO-DIMENSIONAL ARRAYS OF IMPINGING JETS WITH INITIAL CROSSFLOW Ph.D. Thesis
C C J SU 1984 252 p
Avail Univ Microfilms Order No DA8501324

Two-dimensional arrays of circular air jets impinging on a heat transfer surface parallel to the jet orifice plate are considered. The jet flow, after impingement, is constrained to exit in a single direction along the channel formed by the jet orifice plate and heat transfer surface. In addition to the crossflow that originates from the jets following impingement, an initial crossflow is present that approaches the array through an upstream extension of the channel. The configurations considered are intended to model the impingement cooled midchord region of gas turbine airfoils in cases where an initial crossflow is also present. Spanwise averaged heat fluxes, resolved in the streamwise direction to one streamwise jet hole spacing, referred to as regional average fluxes, were measured for twelve arrays each having a different combination of geometric parameter values (streamwise hole spacing, spanwise hole spacing, and channel height each measured relative to jet hole diameter).

Measurements were made over a range of jet flow rates and also for a range of initial crossflow rates relative to jet flow rate.

Dissert Abstr

N85-35372*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif
COMPUTATION OF THREE-DIMENSIONAL SHOCK WAVE AND BOUNDARY-LAYER INTERACTIONS
C M HUNG Aug 1985 15 p refs
(NASA-TM-86780, NAS 1.15 86780, REPT-85350) Avail NTIS
HC A02/MF A01 CSCL 20D

Computations of the impingement of an oblique shock wave on a cylinder and a supersonic flow past a blunt fin mounted on a plate are used to study three dimensional shock wave and boundary layer interaction. In the impingement case, the problem of imposing a planar impinging shock as an outer boundary condition is discussed and the details of particle traces in windward and leeward symmetry planes and near the body surface are presented. In the blunt fin case, differences between two dimensional and three dimensional separation are discussed, and the existence of a unique high speed, low pressure region under the separated spiral vortex core is demonstrated. The accessibility of three dimensional separation is discussed. E A K

N85-35373*# Imperial Coll of Science and Technology, London (England)
VORTEX BOUNDARY-LAYER INTERACTIONS Semiannual Status Report, 1 Mar. - 31 Aug. 1985
P BRADSHAW 31 Aug 1985 15 p
(Contract NAGW-581)
(NASA-CR-176192, NAS 1 26 176192) Avail NTIS HC A02/MF
A01 CSCL 20D

The interaction of a turbulent boundary layer on a flat plate with a strong artificially generated longitudinal vortex which may or may not actually enter the boundary layer is studied. The vortices are generated by a delta wing suspended ahead of the test plate, so that the configuration is approximately that of a close coupled carnauld with zero main-wing sweep and an invisible body. All necessary configuration and parametric checks are completed, and data acquisition and analysis on the first configuration chosen for detailed study, in which the vortex starts to merge with the boundary layer a short distance downstream of the leading edge of the test plate, are nearly complete. Author

N85-35391*# Pratt and Whitney Aircraft, East Hartford, Conn
Engineering Div
DEVELOPMENT OF ADVANCED HIGH-TEMPERATURE HEAT FLUX SENSORS. PHASE 2: VERIFICATION TESTING Final Report
W H ATKINSON, M A CYR, and R R STRANGE Aug 1985
69 p refs
(Contract NAS3-22133)
(NASA-CR-174973, NAS 1 26 174973, PWA-5914-39) Avail
NTIS HC A04/MF A01 CSCL 14B

A two-phase program is conducted to develop heat flux sensors capable of making heat flux measurements throughout the hot section of gas turbine engines. In Phase 1, three types of heat flux sensors are selected; embedded thermocouple, laminated, and Gardon gauge sensors. A demonstration of the ability of these sensors to operate in an actual engine environment is reported. A segmented liner of each of two combustors being used in the Broad Specification Fuels Combustor program is instrumented with the three types of heat flux sensors then tested in a high pressure combustor. Radiometer probes are also used to measure the radiant heat loads to more fully characterize the combustor environment. Test results show the heat flux sensors to be in good agreement with radiometer probes and the predicted data trends. In general, heat flux sensors have strong potential for use in combustor development programs. Author

12 ENGINEERING

N85-35423*# Lockheed Missiles and Space Co., Huntsville, Ala Research and Engineering Center
STUDY OF NSI AND RELATED CABLE PERFORMANCE DURING TESTS PERFORMED IN THE NASA HOT GAS FACILITY
Z S KARU Jan 1982 32 p
(Contract NAS8-32982)
(NASA-CR-170886, NAS 1 26 170886, LMSC-HREC-TM-D784644)
Avail NTIS HC A03/MF A01 CSCL 20K

Some seven different configurations of the NSI and other cables were tested in the NASA-MSFC Hot Gas Facility (HGF). The tests were conducted to study what happens to the cables when they are exposed to hot flow as was the case in the first two Shuttle flights, the STS-1 and STS-2. Protection of these components is vital for various functions especially to attain proper nozzle separation. The tests in the HGF demonstrated the severity of the aerodynamic forces combined with aero heating environment on the test cables and helped, in general, to evaluate the cable wrap materials and cable mounting hardware and technique. Blastape 2 cable wrap which is adequate for thermal protection of the cables must be properly clamped at its ends. The nylon clamps (or ties) used to secure cables to metal components inside the skirt could not withstand the heating. K5NA closeout material used on the outboard surface of the aft skirt when troweled over the cables performed excellently in protecting the cables and mounting hardware. Author

N85-35425# Airtech Precision Shot Peening, Livonia, Mich
DEVELOPMENT OF A MATHEMATICAL MODEL FOR PREDICTING THE PERCENTAGE FATIGUE LIFE INCREASE RESULTING FROM SHOT PEENED COMPONENTS Final Report, Sep. 1983 - Apr. 1984
R S SIMPSON Wright-Patterson AFB, Ohio AFWAL Apr 1985 47 p
(Contract F33615-83-C-3252)
(AD-A155774, AFWAL-TR-84-3116) Avail NTIS HC A03/MF A01 CSCL 12A

Shot peening is used extensively in many aircraft structural and engine applications to enhance fatigue life and stress corrosion resistance. Recent research indicates that high shot peening intensities can produce a phenomenon called peened surface extrusion folds (PSEF) which is hypothesized to result in fatigue life reductions. In this investigation more than one hundred specimens of 7075-T6 and 7075-T73 aluminum material were manufactured and treated at various levels of shot peening intensity, almen saturation level, and peening media size. Specimens were subsequently fatigue tested under axial loading conditions. The longest fatigue life was obtained at relatively low almen intensities with the smallest size glass bead at 100 to 110% almen saturation. Intensity vs fatigue life patterns were similar for both materials. The optimum intensity level was substantially below that specified in MIL-STD-852. Scanning electron microscopy and metallography showed increasing depth and quantity of PSEF and embedded glass bead particles at the surface as peening intensity increased. Test work demonstrated statistically significant effects of PSEF, embedded glass particles, percent of almen saturation, part material hardness, and peening media size on specimen fatigue life. Multiple linear statistical regression of these four variables accounted for a high percentage of the variance in specimen fatigue life. Author (GRA)

N85-35556# Technische Univ., Munich (West Germany)
Lehrstuhl fuer Flugmechanik und Flugregelung
DEVELOPMENT AND OPERATION OF A MEASURING DATA ACQUISITION SYSTEM FOR USE IN LIGHT AIRPLANES [ENTWICKLUNG UND BETRIEB EINER MESSDATENERFASSUNGSANLAGE (MEA) FUER DEN EINSATZ IN LEICHTFLUGZEUGEN]
P HUBER In DFVLR Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 157-160 Jan 1985 In GERMAN
Avail NTIS HC A10/MF A01

A data acquisition system weighing 35 kg is developed for use onboard light aircraft. The basic concept of the system (task definition, requirements) is given. Development status (onboard

components, special systems, ground components, measuring data recorder, technical data, and data evaluation software) is presented. The performed measurements are reviewed. Author (ESA)

13

GEOSCIENCES

Includes geosciences (general), earth resources, energy production and conversion, environment pollution, geophysics, meteorology and climatology, and oceanography

A85-47264#

IN-FLIGHT ELECTRICAL CONDUCTIVITY MEASUREMENTS
P GONDOT and A DELANNOY (ONERA, Chatillon-sous-Bagneux, France) (International Conference on Lightning and Static Electricity, Paris, France, June 10-12, 1985) ONERA, TP, no 1985-61, 1985, 6 p DRET-supported research refs
(ONERA, TP NO 1985-61)

Convective cloud electrical behavior is related to such global parameters as the atmospheric electric field, and to such local phenomena as the electrical charge of drops and droplets and their ionic conductivity. ONERA has conducted cloud conductivity sensor development efforts based on the Gerdien design, and deployed such sensors aboard a Transall aircraft during a thundercloud and lightning flash study campaign in southwestern France held in the spring of 1984. The three different sensors used were respectively distinguished by (1) automatic bias for conductivity, ionic density, and mobility measurements, (2) high voltage bias with a multireceiver electrode for fast analysis of cloud transition zones, and (3) adjustable bipolar high voltage bias. O C

N85-34444*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
REFLECTION PLANE TESTS OF A WIND TURBINE BLADE TIP SECTION WITHAILERONS Final Report
J M SAVINO, T W NYLAND, A G BIRCHENOUGH, F L JORDAN (NASA, Langley Research Center), and N K CAMPBELL (NASA, Langley Research Center) Aug 1985 57 p refs
(Contract DE-AI01-79ET-20320)
(NASA-TM-87018, E-2564, DOE/NASA/20320-65, NAS 1 15 87018) Avail NTIS HC A04/MF A01 CSCL 10A

Tests were conducted in the NASA Langley 30 by 60 foot Wind Tunnel on a full scale 7.31 m (24 ft) long tip section of a wind turbine rotor blade. The blade tip section was built with ailerons on the trailing edge. The ailerons, which spanned a length of 6.1 m (20 ft), were designed so that two types could be evaluated: the plain and the balanced. The ailerons were hinged on the suction surface at the 0.62 X chord station behind the leading edge. The purpose of the tests was to measure the aerodynamic characteristics of the blade section for an angle of attack range from 0 deg to 90 deg aileron deflections from 0 deg to -90 deg, and Reynolds numbers of 0.79 and 1.5 x 10 to the 6th power. These data were then used to determine which aileron configuration had the most desirable rotor control and aerodynamic braking characteristics. Tests were also run to determine the effects of vortex generators, leading edge roughness, and the gaps between the aileron sections on the lift, drag, and chordwise force coefficients of the blade tip section. Author

N85-35534*# PRC Planning and Economics, Inc., Lake Success, NY.

COMPARATIVE ANALYSIS OF OPERATIONAL FORECASTS VERSUS ACTUAL WEATHER CONDITIONS IN AIRLINE FLIGHT PLANNING, VOLUME 1

J F KEITZ Apr 1982 83 p 5 Vol

(Contract NAS3-22748)

(NASA-CR-167862, NAS 1 26 167862) Avail NTIS HC A05/MF A01 CSCL 04B

The impact of more timely and accurate weather data on airline flight planning with the emphasis on fuel savings is studied. This volume of the report discusses the results of Task 1 of the four major tasks included in the study. Task 1 compares flight plans based on forecasts with plans based on the verifying analysis from 33 days during the summer and fall of 1979. The comparisons show that: (1) potential fuel savings conservatively estimated to be between 1.2 and 2.5 percent could result from using more timely and accurate weather data in flight planning and route selection, (2) the Suttland forecast generally underestimates wind speeds, and (3) the track selection methodology of many airlines operating on the North Atlantic may not be optimum resulting in their selecting other than the optimum North Atlantic Organized Track about 50 percent of the time. Author

N85-35535*# PRC Planning and Economics, Inc., Lake Success, NY.

COMPARATIVE ANALYSIS OF OPERATIONAL FORECASTS VERSUS ACTUAL WEATHER CONDITIONS IN AIRLINE FLIGHT PLANNING, VOLUME 2

J F KEITZ Apr 1982 54 p 5 Vol.

(Contract NAS3-22748)

(NASA-CR-167863, NAS 1 26 167863) Avail NTIS HC A04/MF A01 CSCL 04B

The impact of more timely and accurate weather data on airline flight planning with the emphasis on fuel savings is studied. This volume of the report discusses the results of Task 2 of the four major tasks included in the study. Task 2 compares various categories of flight plans and flight tracking data produced by a simulation system developed for the Federal Aviation Administration by SRI International (Flight tracking data simulate actual flight tracks of all aircraft operating at a given time and provide for rerouting of flights as necessary to resolve traffic conflicts.) The comparisons of flight plans on the forecast to flight plans on the verifying analysis confirm Task 1 findings that wind speeds are generally underestimated. Comparisons involving flight tracking data indicate that actual fuel burn is always higher than planned, in either direction, and even when the same weather data set is used. Since the flight tracking model output results in more diversions than is known to be the case, it was concluded that there is an error in the flight tracking algorithm. Author

N85-35536*# PRC Planning and Economics, Inc., Lake Success, NY.

COMPARATIVE ANALYSIS OF OPERATIONAL FORECASTS VERSUS ACTUAL WEATHER CONDITIONS IN AIRLINE FLIGHT PLANNING, VOLUME 3

J F KEITZ Apr 1982 96 p 5 Vol

(Contract NAS3-22748)

(NASA-CR-167864, NAS 1 26 167864) Avail NTIS HC A05/MF A01 CSCL 04B

The impact of more timely and accurate weather data on airline flight planning with the emphasis on fuel savings is studied. This volume of the report discusses the results of Task 3 of the four major tasks included in the study. Task 3 compares flight plans developed on the Suttland forecast with actual data observed by the aircraft (and averaged over 10 degree segments). The results show that the average difference between the forecast and observed wind speed is 9 kts without considering direction, and the average difference in the component of the forecast wind parallel to the direction of the observed wind is 13 kts. - both indicating that the Suttland forecast underestimates the wind speeds. The Root Mean Square (RMS) vector error is 30.1 kts. The average absolute difference in direction between the forecast

and observed wind is 26 degrees and the temperature difference is 3 degree Centigrade. These results indicate that the forecast model as well as the verifying analysis used to develop companion flight plans in Tasks 1 and 2 is a limiting factor and that the average potential fuel savings or penalty are up to 3.6 percent depending on the direction of flight. Author

N85-35537*# PRC Planning and Economics, Inc., Lake Success, NY.

COMPARATIVE ANALYSIS OF OPERATIONAL FORECASTS VERSUS ACTUAL WEATHER CONDITIONS IN AIRLINE FLIGHT PLANNING, VOLUME 4

J F KEITZ Apr 1982 93 p 5 Vol

(Contract NAS3-22748)

(NASA-CR-167865, NAS 1 26 167865) Avail NTIS HC A05/MF A01 CSCL 04B

The impact of more timely and accurate weather data on airline flight planning with the emphasis on fuel savings is studied. This volume of the report discusses the results of Task 4 of the four major tasks included in the study. Task 4 uses flight plan segment wind and temperature differences as indicators of dates and geographic areas for which significant forecast errors may have occurred. An in-depth analysis is then conducted for the days identified. The analysis shows that significant errors occur in the operational forecast on 15 of the 33 arbitrarily selected days included in the study. Wind speeds in an area of maximum winds are underestimated by at least 20 to 25 kts on 14 of these days. The analysis also shows that there is a tendency to repeat the same forecast errors from prog to prog. Also, some perceived forecast errors from the flight plan comparisons could not be verified by visual inspection of the corresponding National Meteorological Center forecast and analyses charts, and it is likely that they are the result of weather data interpolation techniques or some other data processing procedure in the airlines' flight planning systems. Author

N85-35538*# PRC Planning and Economics, Inc., Lake Success, NY.

COMPARATIVE ANALYSIS OF OPERATIONAL FORECASTS VERSUS ACTUAL WEATHER CONDITIONS IN AIRLINE FLIGHT PLANNING: SUMMARY REPORT

J F KEITZ Apr 1982 47 p 5 Vol

(Contract NAS3-22748)

(NASA-CR-167866, NAS 1 26 167866) Avail NTIS HC A03/MF A01 CSCL 04B

The impact of more timely and accurate weather data on airline flight planning with the emphasis on fuel savings is studied. This summary report discusses the results of each of the four major tasks of the study. Task 1 compared airline flight plans based on operational forecasts to plans based on the verifying analyses and found that average fuel savings of 1.2 to 2.5 percent are possible with improved forecasts. Task 2 consisted of similar comparisons but used a model developed for the FAA by SRI International that simulated the impact of ATC diversions on the flight plans. While parts of Task 2 confirm the Task 1 findings, inconsistency with other data and the known impact of ATC suggests that other Task 2 findings are the result of errors in the model. Task 3 compares segment weather data from operational flight plans with the weather actually observed by the aircraft and finds the average error could result in fuel burn penalties (or savings) of up to 3.6 percent for the average 8747 flight. In Task 4 an in-depth analysis of the weather forecast for the 33 days included in the study finds that significant errors exist on 15 days. Wind speeds in the area of maximum winds are underestimated by 20 to 50 kts, a finding confirmed in the other three tasks. Author

N85-35539*# University Corp for Atmospheric Research, Boulder, Colo

A PRELIMINARY INTERCOMPARISON BETWEEN NUMERICAL UPPER WIND FORECASTS AND RESEARCH AIRCRAFT MEASUREMENTS OF JET STREAMS

M A SHAPIRO 15 Apr 1982 10 p Sponsored by NASA (NASA-CR-167884, NAS 1 26 167884) Avail NTIS HC A02/MF A01 CSDL 04B

During the past several years, research on the structure of extra-tropical jet streams has been carried out with direct measurements with instrumented research aircraft from the National Center for Atmospheric Research (NCAR). These measurements have been used to describe the wind, temperature, turbulence and chemical characteristics of jet streams. A fundamental question is one of assessing the potential value of existing operational numerical forecast models for forecasting the meteorological conditions along commercial aviation flight routes so as to execute Minimum Flight Time tracks and thus obtain the maximum efficiency in aviation fuel consumption. As an initial attempt at resolving this question, the 12 hour forecast output from two models was expressed in terms of a common output format to ease their intercomparison. The chosen models were (1) the Fine-Mesh Spectral hemispheric and (2) the Limited Area Fine Mesh (LFM) model. Author

N85-35540*# Dayton Univ, Ohio Research Inst
THE PHYSICAL AND EMPIRICAL BASIS FOR A SPECIFIC CLEAR-AIR TURBULENCE RISK INDEX Final Report

J L KELLER Aug 1985 47 p refs
(Contract NAS8-34678)
(NASA-CR-178522, NAS 1 26 178522, UDR-TR-85-94) Avail NTIS HC A03/MF A01 CSDL 04B

An improved operational CAT detection and forecasting technique is developed and detailed. This technique is the specific clear air turbulence risk (SCATR) index. This index shows some promising results. The improvements seen using hand analyzed data, as a result of the more realistic representation of the vertical shear of the horizontal wind, are also realized in the data analysis used in the PROFS/CWP application. The SCATR index should improve as database enhancements such as profiler and VAS satellite data, which increase the resolution in space and time, are brought into even more sophisticated objective analysis schemes. E R

N85-35542# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Inst fuer Physik der Atmosphaere

PROCEEDINGS OF METEOROLOGICAL MOTOR GLIDER (MEMO) WORKSHOP '84

Jan 1985 213 p refs Partly in ENGLISH and GERMAN Proc held at Oberpfaffenhofen, West Ger, 1-5 Oct 1985 Report will also be announced as translation (ESA-TT-945) (DFVLR-MITT-85-04, ISSN-0176-7739) Avail NTIS HC A10/MF A01

Motor glider meteorology and the history of motor gliders used for meteorological flight are reviewed. Vertical wind velocity determination using aircraft motion is discussed. Meteorological data from the Falcon aircraft and the ASK 16 motor glider are compared. Atmospheric boundary layer turbulence is investigated. Environmental meteorological data in urban areas are examined. The concept of Lagrangian partitioning was applied to turbulent energy transport. Horizontal and vertical structure of the boundary layer, and the energy budgets above rural and urban areas are treated. Lee circulation in a Fohn wind is studied. Meteorological measuring campaigns with instrumented motor gliders in Poland are reviewed. A data acquisition system for meteorological measurements onboard light aircraft is developed. Accuracy and error analysis of meteorological measuring data is considered. The principles of wind velocity measurements onboard research aircraft are presented.

N85-35543# Bonn Univ (West Germany) Inst fuer Meteorologie

MOTOR GLIDER METEOROLOGY [MOTORSEGLER-METEOROLOGIE]

H KRAUS /In DFVLR Proc of Meteorol Motor Glider (MEMO) Workshop '84 P 11-13 Jan 1985 In GERMAN
Avail NTIS HC A10/MF A01

Methods of dividing meteorological sciences in partial domains are given, and the requirements and tasks of motor glider meteorology are depicted. It is explained that motor gliders are especially suited for the experimental determination of processes and structures on a micro and mesoscale and of micro-mesoscale interactions. Author (ESA)

N85-35545# Eidgenoessisches Inst fuer Reaktorforschung, Wuerenlingen (Switzerland)

DETERMINATION OF VERTICAL AIR VELOCITY USING MEASUREMENTS OF THE AIRCRAFT MOTION [BESTIMMUNG DER VERTIKALGESCHWINDIGKEIT DER LUFT MIT HILFE VON MESSUNGEN DER FLUGZEUGBEWEGUNG]

M HUTTER /In DFVLR Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 29-42 Jan 1985 refs In GERMAN
Avail NTIS HC A10/MF A01

Absolute air velocity is determined from the movements of an aircraft. Determination of aircraft motion in a vertical plane is described, the vertical equation of motion and the calculation of an average position angle are discussed. Good agreement is found between measured and calculated angles. The sensitivity of the results to the position angle is discussed. Author (ESA)

N85-35546# Technische Univ, Brunswick (West Germany) Inst fuer Flugfuehrung

CONTROL VARIABLES IN VERTICAL WIND DETERMINATION USING SIMPLE FLIGHT-MECHANICAL EQUATIONS [EINFLUSSGROESSEN BEI DER VERTIKALWINDBESTIMMUNG MIT EINFACHEN FLUGMECHANISCHEN GLEICHUNGEN]

K U HAHN and C J JIN /In DFVLR Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 43-60 Jan 1985 refs In GERMAN
Avail NTIS HC A10/MF A01

A measuring method for the determination of the vertical wind velocity using small measuring aircraft (e.g., motor gliders) is developed. During the flight through a wind field, wind velocity fluctuations act on the aircraft in the form of additional forces. Aircraft reactions to these perturbations depend strongly on the steering maneuvers of the pilot. From this response behavior of the aircraft conclusions can be drawn as to the wind behavior if the aircraft dynamics are precisely known. The wind determination procedure can be simplified if only vertical wind is taken into account and if stationary behavior is assumed. The validity domain of these simplifying assumptions and the effect of measuring quantity errors (investigated by simulations) are discussed. Author (ESA)

N85-35547# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Inst fuer Physik der Atmosphaere

A COMPARISON BETWEEN FALCON DATA AND MOTOR GLIDER DATA [EIN VERGLEICH VON FALCON-DATEN MIT MOTORSEGLER-DATEN]

H WILLEKE /In its Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 61-68 Jan 1985 refs In GERMAN
Avail NTIS HC A10/MF A01

The data of the Falcon aircraft and the ASK 16 motor glider meteorological flight under the same meteorological conditions are compared to estimate errors in the determination of the vertical wind component. Flight data and equipment of both aircraft are listed. The flight programs, data evaluation, and comparison method are described. The parameters measured by both aircraft are listed. The power spectra to the vertical velocity show good agreement. The differing relative deviations in heat fluxes shows that at least one unknown effect occurs. Author (ESA)

N85-35548# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Inst fuer Physik der Atmosphaere

CASE STUDIES FOR FLUX MEASUREMENTS ALONG A LOW-FLYING ROUTE TO THE SOUTH OF MUNICH [FALLSTUDIEN ZU FLUSSMESSUNGEN ENTLANG EINER TIEFFLUGSTRECKE SUEDLICH VON MUENCHEN]

M E REINHARDT *In its* Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 69-79 Jan 1985 refs In GERMAN

Avail. NTIS HC A10/MF A01

Turbulent, sensible, and latent heat fluxes along low flying motor glider routes are measured to study the atmospheric boundary layer. The behavior of sensible and latent heat fluxes on days with different meteorological conditions is discussed. Normalized frequency distributions of all measured vertical accelerations during measuring of flights are shown. Improvements of the measuring strategy are proposed to allow deeper analysis of the fine structure of atmospheric boundary layer phenomena. Author (ESA)

N85-35549# Eidgenoessisches Inst fuer Reaktorforschung, Wuerenlingen (Switzerland)

ENVIRONMENTAL-PHYSICAL MEASUREMENTS AND DETERMINATION OF ATMOSPHERIC TURBULENCE WITH THE ASK-16 MOTOR GLIDER [UMWELTPHYSIKALISCHE MESSUNGEN UND ERFASSUNG ATMOSPHAERISCHER TURBULENZ MIT DEM MOTORSEGLER ASK-16]

M HUTTER *In* DFVLR Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 81-89 Jan 1985 refs In GERMAN

Avail. NTIS HC A10/MF A01

Meteorological motor glider flights are performed to determine environmental and atmospheric turbulence parameters. Temperature and humidity probes used in the project CLIMOD (climate modification) studying the effect of increasing urbanization and planned nuclear power plants with their cooling system on the climate, and the results of the measurements and model calculations are discussed. Ozone in the lower troposphere due to the existence of smog reactions in the neighborhood of Zurich is investigated in ground stations and with two captive balloons; the regional ozone distribution was measured by motor gliders; the measurements strongly point at the Zurich agglomeration as the origin of the ozone-rich air. The motions of motor gliders due to air flows are used to determine atmospheric turbulence in the wavelength domain between 10 and 100 m; the measurements confirm previous results. Agreement between the measurements and a mathematical turbulence parameterization model is found. Author (ESA)

N85-35550# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Inst fuer Physik der Atmosphaere

MEASUREMENTS FOR THE DETERMINATION OF THE VERTICAL STRUCTURE OF THE CONVECTIVE BOUNDARY LAYER [MESSUNGEN ZUR VERTIKAL STRUKTUR DER KONVEKTIVEN GRENZSCHICHT]

A. M. JOCHUM *In its* Proc of Meteorol Motor Glider (MEMO) '84 Workshop p 91-97 Jan 1985 refs In GERMAN

Avail. NTIS HC A10/MF A01

A meteorological measuring campaign with motor gliders is performed to investigate turbulent vertical transport in the convective boundary layer and the spatial structure of thermal air fields. The measuring procedures are described. The vertical profiles measured and normalized (mixed-layer scaling) can be well integrated in the framework of similar profiles. Author (ESA)

N85-35551# Bonn Univ (West Germany). Inst. fuer Meteorologie.

PARTITIONING OF THE VERTICAL TURBULENT ENERGY TRANSPORT INTO POSITIVE AND NEGATIVE CONTRIBUTIONS [AUFSPLITZUNG DER VERTIKALEN TURBULENTEN ENERGIETRANSPORTE IN POSITIVE UND NEGATIVE BEITRAEGE]

J M HACKER *In* DFVLR Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 99-114 Jan 1985 refs In GERMAN

Avail. NTIS HC A10/MF A01

The concept of Lagrangian partitioning is applied to motor glider meteorological flight measuring series in order to study which single processes contribute to the turbulent net vertical transport of sensible and latent heat. Normalization and data evaluation procedures are described. It is found that in the upper level of the inversion layer the net fluxes consist of much higher single contributions than in the lower level, especially for the sensible heat flux. At both levels the moist, then hot, wakes give the largest contribution to the direct circulations, while the hot wakes give the largest contribution to the indirect circulations. For sensible heat the intensities of the processes due to hot air dominate at both levels. For latent heat the intensities of the processes due to moist air only dominate at the lower level. Author (ESA)

N85-35552# Bonn Univ (West Germany) Inst fuer Meteorologie

AIRCRAFT MEASUREMENTS DURING THE BONN EXPERIMENT (BONEX 1) [DIE FLUGZEUGMESSUNGEN WAERHEND DES EXPERIMENTES BONEX 1]

V KESPE *In* DFVLR Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 115-133 Jan 1985 refs In GERMAN

Avail. NTIS HC A10/MF A01

Meteorological measurements are performed to investigate the horizontal and vertical structure of the atmospheric boundary layer. Two captive balloon systems, an energy budget station, and instrumented motor gliders are used. The synoptic measuring situation is described. The effect of the mask on the motor glider measurements of the lowest flight level is discussed. The spatial and temporal variation of the standard deviations of vertical wind velocity, potential temperature, and specific humidity, and of the correlation coefficients, as well as the turbulent fluxes of sensible and latent heat are obtained. The profile of the standard deviations are discussed. Author (ESA)

N85-35554# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Inst fuer Physik der Atmosphaere

THE DETERMINATION OF LEE CIRCULATION DURING THE FOEHN WIND [ZUR BESTIMMUNG DER LEE-ZIRKULATION BEI FOEHN]

K P HOINKA *In its* Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 143-149 Jan 1985 refs In GERMAN

Avail. NTIS HC A10/MF A01

A field experiment, including measurements with motor gliders, are conducted to determine the circulation above and in the lee of the Alps during the foehn wind. Pressure, temperature, and humidity are measured and the isentropes are analyzed. Flow lines and trajectones agree with the isentropes, under the assumption that the flow is two-dimensional, frictionless, and adiabatic. The results show that motor gliders can provide an important contribution to the investigation of partial problems, as in the case of foehn, especially in connection with other measurements and investigation methods. Author (ESA)

N85-35555# Warsaw Univ (Poland) Inst of Geophysics. **METEOROLOGICAL MEASUREMENTS WITH MOTOR GLIDERS IN POLAND**

S. P. MALINOWSKI *In* DFVLR Proc of Meteorol Motor Glider (MEMO) Workshop '84 p 151-156 Jan 1985 refs

Avail. NTIS HC A10/MF A01

Meteorological measuring campaigns with instrumental motor gliders study small scale humidity and temperature inhomogeneities.

13 GEOSCIENCES

caused by dissipating cumulus clouds, and the invisible parts of cooling tower plumes. A program to investigate entrainment and mixing processes in small cumulus clouds is outlined. The motor glider instrumentation and the specification of the measuring unit are presented. The motor glider SZD-45 Ogar is described.

Author (ESA)

N85-35557# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany) Inst fuer Flugmechanik

ACCURACY AND ERROR ANALYSIS [GENAUIGKEITS- UND FEHLERANALYSE]

J SKUDRIDAKIS *In its Proc of Meteorol Motor Glider (MEMO) Workshop '84* p 161-194 Jan 1985 refs In GERMAN
Avail NTIS HC A10/MF A01

Accuracy estimation and error analysis of physical quantities measured during flights are treated. The standard deviation of the Gaussian distribution as criterion for the uncertainty of the measured quantity is discussed. Accuracy estimates via the covariance matrices of the state and measurement equations, and via system identification are explained. The effect of the measurement precision, and a dynamic angle of attack equation are given. The example of air and recovery temperature measurement is presented.

Author (ESA)

N85-35558# Technische Univ, Brunswick (West Germany) Inst fuer Flugfuehrung

THE PRINCIPLES OF WIND MEASUREMENT WITH THE HELP OF AIRCRAFT [GRUNDLAGEN DER WINDMESSUNG MIT HILFE VON FLUGZEUGEN]

P VOERSMANN *In DFVLR Proc of Meteorol Motor Glider (MEMO) Workshop '84* p 195-205 Jan 1985 refs In GERMAN, ENGLISH summary
Avail NTIS HC A10/MF A01

The three components of the wind vector are computed in real time by taking the difference between the inertial velocity and the true airspeed. To perform this calculation, it is necessary to transform the true airspeed from the aerodynamic to the Earth-fixed coordinate system. This coordinate transformation contains numerous trigonometric functions (sine and cosine functions), which yield nonlinear relations for the determination of the wind vector components. These relations present the theoretical principles for measuring winds onboard an aircraft.

Author (ESA)

14

LIFE SCIENCES

Includes life sciences (general), aerospace medicine, behavioral sciences, man/system technology and life support, and planetary biology.

A85-48099

FAST-JET AIRCREW SAFETY

J FARLEY (British Aerospace, PLC, Dunsfold, England) *Flight International* (ISSN 0015-3710), vol 128, Aug 31, 1985, p 25-29

An evaluation is made of tactical combat aircraft crew safety equipment development and performance, with specific reference to RAF experience with Hawk and Harrier fighter crew ejection incidents. The conditions for maximum likelihood of survivability and minimization of injuries are assessed for various aircrew equipment assemblies (encompassing helmets and oxygen masks, life preservers, personal equipment connectors, antigravity suits, emergency intercoms, and seats and harnesses), in light of recorded crew ejection and man/seat separation cases.

O C

A85-48860

FLIGHT MANAGEMENT SYSTEMS CREATE NEW CREW TRAINING NEEDS

M K DEJONGE (Lear Siegler, Inc, Instrument Div, Grand Rapids, MI) *ICAO Bulletin*, vol 40, May 1985, p 29-31

Flight Management Computer Systems (FMCS) are now part of every newly introduced aircraft. These systems interface with the pilot through a control/display unit, the design of which varies considerably according to the manufacturer of the aircraft or the FMCS, making it necessary to train the pilot for every new or upgraded FMCS. To supplement the training manuals, the existing audio-visual slide-show packages, and the touch-screen systems, a novel hands-on method involving a table-top flight simulator interfaced with the actual FMCS hardware has been introduced. In a set-up developed for Boeing, the FMCS for the B-737-300 is interfaced with an inexpensive Commodore personal computer, which is programmed to provide a simulator of the flight instruments and controls, the autopilot, autothrottle, and the aircraft and engine dynamics, enabling the students to operate the FMCS in a dynamic flight situation, with an aircraft's own navigation data base in the FMCS.

I S

15

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general), computer operations and hardware, computer programming and software, computer systems, cybernetics, numerical analysis, statistics and probability, systems analysis, and theoretical mathematics.

A85-47676

1984 AMERICAN CONTROL CONFERENCE, SAN DIEGO, CA, JUNE 6-8, 1984, PROCEEDINGS. VOLUMES 1, 2 & 3

Conference sponsored by the American Automatic Control Council New York, IEEE, 1984, Vol 1, 623 p, vol 2, 628 p, vol 3, 772 p. For individual items see A85-47677 to A85-47803.

The topics considered are related to the modeling of human cognitive decision processes, sensor-based robot control systems, adaptive control and applications, modelling and simulation of thermofluid processes and systems, advanced concepts for computer-aided control system design, model reduction and large scale systems, fuel-optimal aircraft guidance and control, and digital signal processing. Other subjects explored are concerned with the dynamical systems approach to problems in nonlinear systems and control, monitoring and fault detection in power systems, robot path planning and control, the real time control of processes, pole placement design, large scale systems and model reduction, and aircraft control. Attention is also given to servomechanisms and machine tool control, stochastic systems, process model-based control and analysis, applications of multivalued logic, microprocessor implementation of real time control systems using high order languages, multitarget tracking, digital systems, filtering and estimation, optimal control, and fault tolerant aerospace systems.

G R

A85-47681

PARAMETER SPACE DESIGN OF CONTROL SYSTEMS USING INTERACTIVE COMPUTER GRAPHICS

P PUTZ and M J WOZNY (Rensselaer Polytechnic Institute, Troy, NY) *IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 1* New York, IEEE, 1984, p 105-114. Research supported by the Rensselaer Polytechnic Institute and General Electric Co. refs
(Contract NSF ISP-70-20240)

This paper presents contributions to computer-aided control system design in the parameter space approach. Newly developed modeling algorithms allow the use of three-dimensional interactive computer graphics as a powerful and very flexible tool for multivariable control system design. Robustness with respect to

plant variation and sensor failures, actuator constraints, sensor noise and quantization effects in addition to specifications about stability, damping, and bandwidth are handled in a direct geometric way by working with admissible regions of several design parameters. An interactive CAD software package with these capabilities is discussed and several design examples demonstrate the potential and versatility of the method. Author

A85-47704* National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
**A REAL-TIME FORTRAN IMPLEMENTATION OF A SENSOR
FAILURE DETECTION, ISOLATION AND ACCOMMODATION
ALGORITHM**

J C DELAAT (NASA, Lewis Research Center, Cleveland, OH)
IN 1984 American Control Conference, San Diego, CA, June 6-8,
1984, Proceedings Volume 1 New York, IEEE, 1984, p 572,
573 refs

An advanced, sensor failure detection, isolation, and accommodation algorithm has been developed by NASA for the F100 turbofan engine. The algorithm takes advantage of the analytical redundancy of the sensors to improve the reliability of the sensor set. The method requires the controls computer, to determine when a sensor failure has occurred without the help of redundant hardware sensors in the control system. The controls computer provides an estimate of the correct value of the output of the failed sensor. The algorithm has been programmed in FORTRAN using a real-time microprocessor-based controls computer. A detailed description of the algorithm and its implementation on a microprocessor is given. I H

A85-47735* Drexel Univ., Philadelphia, Pa
MODAL INSENSITIVITY WITH OPTIMALITY

A J CALISE and K V RAMAN (Drexel University, Philadelphia, PA)
IN 1984 American Control Conference, San Diego, CA,
June 6-8, 1984, Proceedings Volume 2 New York, IEEE, 1984,
p 949-953 refs
(Contract N00014-77-C-0642, NAG1-243)

This paper deals with the design of a constant gain, feedback controller which results in selected modal insensitivity, and at the same time optimizes a quadratic performance index representative of desired system performance for nominal plant parameter values. Both full state and output feedback control are considered. A constraint is established for the feedback gain matrix that results in modal insensitivity, and necessary conditions for optimality subject to this constraint are given. This forms the basis for a numerical algorithm to compute the optimal feedback gain. To illustrate the procedure, a design is carried out using the lateral dynamics of an L-1011 aircraft. Author

A85-47769
**A NEW APPROACH TO THE MANEUVERING TARGET
TRACKING PROBLEM**

N O SPEAKMAN (USAF, Armament Laboratory, Eglin AFB, FL)
and T E BULLOCK (Florida, University, Gainesville) IN 1984
American Control Conference, San Diego, CA, June 6-8, 1984,
Proceedings Volume 3 New York, IEEE, 1984, p 1404, 1405
refs

A description is given of the theoretical basis for a new autoregressive moving-average (ARMA) model identification method. Attention is given to an algorithm which determines the minimum order n of an ARMA model, relationships to the Kalman filter, and applications to target dynamic modelling. By applying a new method to an identification of ARMA model parameters, it is shown that a simulated aircraft acceleration can be accurately modeled with ARMA models. Applications to the design of tracking filter dynamic models appear to be obvious. G R.

A85-47774

A DISTRIBUTED AEROACOUSTIC TRACKING ALGORITHM

R R TENNEY (MIT, Cambridge, MA) and J R DELANEY (MIT, Lexington, MA) IN 1984 American Control Conference, San Diego, CA, June 6-8, 1984, Proceedings Volume 3 New York, IEEE, 1984, p 1440-1450 DARPA-supported research refs

A distributed algorithm is being developed for tracking very-low-flying, subsonic aircraft using geographically dispersed acoustic sensors and colocated data processors linked by a digital radio broadcast communication network. Development of the algorithm serves as a case study of the applicability and limitations of state-of-the-art distributed estimation theory. Three major components of the algorithm are described: the local estimation algorithm, the distributed estimation algorithm, and the communications policy. The local estimation algorithm uses single sensor measurements to improve state estimates in one sensor/processor node. The distributed estimation algorithm combines state estimates computed at different nodes. The communications policy governs the exchange of state estimates between nodes. Performance of the algorithm in simulated tracking experiments is reported. Author

A85-47784

**COMPUTER-AIDED DESIGN OF CONTROL SYSTEMS VIA
PARAMETER OPTIMIZATION METHOD (CADCS/POM) - AN
INTERACTIVE GRAPHICS APPROACH**

T SADEGHI (Fairchild Republic Co., Farmingdale, NY) and M WOZNY (Rensselaer Polytechnic Institute, Troy, NY) IN 1984
American Control Conference, San Diego, CA, June 6-8, 1984,
Proceedings Volume 3 New York, IEEE, 1984, p 1634-1640
refs

This paper describes an interactive graphics approach for computer-aided design of control systems via a parameter optimization method. The approach integrates (1) an optimal proportional-plus-integral control law to achieve tracking, (2) an algorithmic optimization technique to satisfy linear and non-linear constraints, and (3) an interactive graphics approach to utilize the heuristic optimization (human knowledge, experience, and intuition). Where each of the preceding concepts has its unique features, the integrated approach allows minimization of computer and design time beyond minimizing a cost function. Author

A85-47793* Massachusetts Inst of Tech., Cambridge
CONTROL SYSTEM RECONFIGURATION

W E VANDER VELDE (MIT, Cambridge, MA) IN 1984 American
Control Conference, San Diego, CA, June 6-8, 1984, Proceedings
Volume 3 New York, IEEE, 1984, p 1741-1745
(Contract NAG1-126)

The problem of reconfiguring a control system to accommodate the failure of a sensor or actuator is discussed in the context of several different system configurations. First, some ground rules under which the reconfiguration algorithms are to function are established. A variety of control system configurations is then considered, and it is found that the approach to reconfiguration is obvious in some cases but not clear in others. Several possible strategies for reconfiguration, applicable to different situations, are examined. V L

A85-48024

**COMPUTER AND INFORMATION TECHNOLOGY IN THE YEAR
2000 - A PROJECTION**

S F LUNDSTROM (Microelectronics and Computer Technology Corp., Austin, TX) and R L LARSEN (Maryland, University, College Park) Computer (ISSN 0018-9162), vol 18, Sept 1985, p 68-79 refs

The reasoning and conclusions drawn by a panel of experts from the National Research Council who, at the request of NASA, considered information and computer technologies which would be available in the year 2000 are reported. The deliberations covered microelectronics and components, processors, software, AI and expert systems, man-machine interfaces, systems development and implementation and high-integrity systems. It was projected that components would be 2-3 orders of magnitude more

15 MATHEMATICAL AND COMPUTER SCIENCES

cost- and size-effective by the turn of the century Airborne systems would carry 50 Mb RAM and perform operations at 1 GIPS Supercomputers would have been pushed to 1 Tflops with 10 Gwords of RAM and 100-100,000 processing elements The parallel progress in aerospace technologies will directly depend on the degree aerospace engineers access the new computing power

M S K

A85-49005

RECENT ADVANCES IN COMPUTER IMAGE GENERATION

P K DOENGES (Evans and Sutherland Computer Corp, Salt Lake City, UT) IN Aerospace simulation, Proceedings of the Conference, San Diego, CA, February 2-4, 1984 La Jolla, CA, Society for Computer Simulation, 1984, p 27-38

Polygon/area Computer Image Generation (CIG) technology, currently known in product form as CT5, employs parallel processing in order to expand the number of display channels and raster resolution, it also incorporates strongly hierarchical database management and culling CIG architecture has demonstrated configuration flexibility and growth potential, attention is presently given to the last five years' experience with applications of the CT5 architecture, as well as to the prospects for meeting advanced operational and functional performance objectives with such an architecture in the future

O C

A85-49531#

ITAD - A CAD SYSTEM FOR ENVIRONMENTAL RELIABILITY DESIGN

A H MAYER (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 23-26 (Contract F33615-79-C-3421)

The paper describes the ITAD (Integrated Thermal Avionic Design) Computer Aided Design for Reliability System from the points of view of development objectives, design features, development experiences, development status, future possibilities and illustrates a currently operational design scenario for the optimal reliability, minimum life cycle cost placement of electronic parts on a circuit card

Author

A85-49570*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

A USER'S VIEW OF CARE III

S J BAVUSO (NASA, Langley Research Center, Hampton, VA) IN Annual Reliability and Maintainability Symposium, San Francisco, CA, January 24-26, 1984, Proceedings New York, IEEE, 1984, p 382-389 refs

The present computerized reliability predictor for digital fault-tolerant systems whose sizes are of the order of one million Markovian equivalent states, employs advanced stochastic modeling techniques and implements a mixed Markov model that enables it to drastically reduce the state size of hitherto computationally unobtainable models Attention is given to the concepts of failure, fault, and error, in the context of the novel system's fault/error-handling models Examples are drawn from the system's user-friendly interface dialog

O C

N85-34510*# National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

THE IMPACT OF SUPERCOMPUTERS ON EXPERIMENTATION: A VIEW FROM A NATIONAL LABORATORY

V L PETERSON and J O ARNOLD Aug 1985 16 p refs (NASA-TM-86822, REPT-85377, NAS 1 15 86822) Avail NTIS HC A02/MF A01 CSDL 09B

The relative roles of large scale scientific computers and physical experiments in several science and engineering disciplines are discussed Increasing dependence on computers is shown to be motivated both by the rapid growth in computer speed and memory, which permits accurate numerical simulation of complex physical phenomena, and by the rapid reduction in the cost of performing a calculation, which makes computation an increasingly attractive complement to experimentation Computer speed and

memory requirements are presented for selected areas of such disciplines as fluid dynamics, aerodynamics, aerothermodynamics, chemistry, atmospheric sciences, astronomy, and astrophysics, together with some examples of the complementary nature of computation and experiment Finally, the impact of the emerging role of computers in the technical disciplines is discussed in terms of both the requirements for experimentation and the attainment of previously inaccessible information on physical processes

Author

N85-34596 Societe Francaise d'Instruments de Mesure, Massy (France)

IMPLICATIONS OF ARTIFICIAL INTELLIGENCE ON THE DESIGN OF FUTURE ONBOARD SYSTEMS Final Report [IMPLICATIONS DE L'INTELLIGENCE ARTIFICIELLE SUR LA CONCEPTION DES SYSTEMES EMBARQUES FUTURS]

T BILLOIR Dec 1984 80 p refs In FRENCH

(Contract DRET-83-1423)

(SFENA-DPS/C/S3/84252A) Avail Issuing Activity

The applicability of artificial intelligence to aircraft or spacecraft design is discussed A progress report on the research and development of the AMES airborne maintenance expert system is included

Author (ESA)

16

PHYSICS

Includes physics (general), acoustics, atomic and molecular physics, nuclear and high-energy physics, optics, plasma physics, solid-state physics, and thermodynamics and statistical physics

A85-47309

A MORE MODERN THEORY OF COMBUSTION NOISE

W C STRAHLE (Georgia Institute of Technology, Atlanta) IN Recent advances in the aerospace sciences New York, Plenum Press, 1985, p 103-114 refs (Contract NSF CME-80-22366)

Some of the newer concepts that have emerged in the theory of turbulent reacting flows are applied to the problem of combustion-generated noise A general theory is constructed for noise radiation from a turbulent combustion region in the practical limit of low frequency and low Mach number The theory is specialized to simple cases of premixed and nonpremixed jet flames radiating to a free field Comparison with experiment is given for premixed flames A new interpretation is given for the frequency content of combustion noise, which is in accord with experiment

Author

A85-48179

PARAMETRIC ANALYSIS OF THE ACOUSTIC POWER EMITTED BY COAXIAL JETS

V F SAMOKHIN (TsAGI, Uchenye Zapiski, vol 15, no 1, 1984, p 55-64) Fluid Mechanics - Soviet Research (ISSN 0096-0764), vol 12, Nov-Dec 1983 (1985), p 26-36 Translation refs

An analytic model is suggested for calculating the acoustic power of coaxial jets at different degrees of initial turbulence of the outer jet A parametric analysis of the acoustic power emitted by isothermal and nonisothermal coaxial jets is performed Formulas for optimum parameters of jets, ensuring minimum acoustic emission power, are presented

Author

A85-48527#

EXPERIMENTAL RESULTS ON EDGE-TONE OSCILLATIONS IN HIGH-SPEED SUBSONIC JETS

J LEPICOVSKY and K K AHUJA (Lockheed-Georgia Co, Marietta, GA) AIAA Journal (ISSN 0001-1452), vol 23, Oct 1985, p 1463-1468 Research sponsored by the Lockheed-Georgia Co. Previously cited in issue 10, p 1473, Accession no A83-25902. refs

SOCIAL SCIENCES

Includes social sciences (general), administration and management, documentation and information science, economics and cost analysis, law and political science, and urban technology and transportation

A85-49137#

ACOUSTIC INTENSITY TECHNIQUES FOR AIRPLANE CABIN APPLICATIONS

G A DALAN and R L COHEN (Boeing Commercial Airplane Co., Seattle, WA) Journal of Aircraft (ISSN 0021-8669), vol 22, Oct. 1985, p 910-914 Previously cited in issue 10, p. 1475, Accession no A83-25931 refs

A85-50110

NOISE TRANSMISSION CHARACTERISTICS OF AIRCRAFT-TYPE COMPOSITE PANELS

V L METCALF (US Army, Research and Technology Laboratories, Hampton, VA) and F W GROSVELD (Bionetics Corp., Hampton, VA) SAE, General Aviation Aircraft Meeting and Exposition, Wichita, KS, Apr 16-19, 1985 18 p refs (SAE PAPER 850878)

The noise transmission loss characteristics of 28 flat, fiber reinforced, composite panels and 4 aluminum panels, with dimensions of 24.1 cm by 40.6 cm, have been experimentally investigated in the NASA Langley Research Center noise transmission loss apparatus. To support the acoustic data, modal frequencies and modal damping for several mode shapes of each of the test panels were extracted experimentally, using impulse testing with a Computer Aided Test system. It was determined that the modal frequencies and damping ratios are affected by the fiber orientation in the composite panel. The transmission loss of composite panels is compared with that of aluminum panels of equal critical shear load. The effects of applying structural foam and damping material are indicated. Author

N85-34717# Rolls-Royce Ltd., Derby (England) Materials Engineering Group

COST EFFECTIVE SINGLE CRYSTALS: THE ROLLS ROYCE APPROACH

M J GOULETTE, P D SPILLING, and R P ARTHEY 1 Nov 1984 11 p refs Presented at 5th Intern Symp on Superalloys, Seven Springs, England, 1984 (PNR-90262) Avail NTIS HC A02/MF A01

The development of a cost effective single crystal technology, including single crystal casting technique, alloy development, and orientation measurement, is described. The first aspect led to the adoption of the technically more difficult seeding technique as a result of its greater flexibility. The second resulted in the development of a series of three alloys to meet specific turbine applications. The third requirement is met by the development of a rapid and accurate orientation measurement technique suitable for the production environment. Author (ESA)

N85-35690# Deputy Chief of Staff for Research Development and Acquisition (Army), Washington, D C

PROCEEDINGS OF THE 14TH ARMY SCIENCE CONFERENCE. VOLUME 2: PRINCIPAL AUTHORS I THROUGH O

1984 368 p refs Conf held at West Point, N Y, 19-21 Jun 1984 5 Vol (AD-A149201) Avail NTIS HC A16/MF A01 CSCL 05B

Progress and results in military science, technology, and research and development was presented at the 1984 Army Science conference. E A K

N85-35695*# Kansas Univ Center for Research, Inc., Lawrence Flight Research Lab

A RESEARCH PROGRAM TO REDUCE THE INTERIOR NOISE IN GENERAL AVIATION AIRCRAFT, INDEX AND SUMMARY

L MORGAN, K JACKSON, and J ROSKAM Aug 1985 63 p (Contract NSG-1301)

(NASA-CR-176178, NAS 1.26 176178, KU-FRL-417-24) Avail NTIS HC A04/MF A01 CSCL 20A

This report is an index of the published works from NASA Grant NSG 1301, entitled A Research Program to Reduce the Interior Noise in General Aviation Aircraft. Included are a list of all published reports and papers, a compilation of test specimen characteristics, and summaries of each published work. Author

A85-49913

HOW MUCH DOES IT COST/HOW MUCH DOES IT WEIGH?

T E BRENTS, JR (General Dynamics Corp., Fort Worth, TX) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 30 p (SAWE PAPER 1593)

Attention is given to cost estimation method trends in the US military aircraft industry, where weight-drive parametric estimation has been used for such products as the F-16 fighter in order to deliver firm prices on proposed changes. Parametric estimates are also used to provide customers with budgetary information. The engineering change proposal pricing practices presently detailed were first applied in the negotiation of a pricing agreement for tooling in 1980. O C

A85-49914

WEIGHT CONTROL - A PROCUREMENT AGENCY PERSPECTIVE

D M CATE (US Naval Air Systems Command, Washington, DC) SAWE, Annual Conference, 43rd, Atlanta, GA, May 21-23, 1984 14 p (SAWE PAPER 1594)

A procurement agency perspective on the factors which make success in weight control efforts difficult to achieve is presented, with attention to technological uncertainty, psychological pressures toward optimistic estimates, insufficient resources, and competing priorities. It is suggested that these factors can be significantly balanced by undertaking weightings for estimate verification, by the use of derivation and modification programs, and by means of center-of-gravity control. O C

N85-35811# DOD Product Engineering Services Office, Alexandria, Va

DOD VALUE ENGINEERING CONFERENCE REPORT. VALUE ENGINEERING (VE): A TOOL THAT BENEFITS LINE MANAGEMENT HELD AT LEESBURG, VIRGINIA ON 1-2 NOVEMBER 1984. PART 2. PLENARY SESSION

G FRANK and L PAULSON Jun 1985 246 p Conf held at Leesburg, Va, 1-2 Nov 1984 (AD-A156068) Avail NTIS HC A11/MF A01 CSCL 05A

This Conference Report summarizes and consolidates the proceedings from the 1984 DOD Value Engineering Conference held 1 through 2 November in Leesburg, VA. The findings and recommendations with supporting material from the five workshops are provided in addition to the complete plenary session presentations. An Executive Summary is presented in Part 1. Plenary Session Moving Value Engineering Conference, The Hughes Aircraft Company Approach to Value Engineering, E-3A Value Engineering, FMC Value Engineering Program, FAR/DoD FAR Supplement, VECs - the IG View, Collateral Savings - The Real Challenge, Where's the Map?, and A Value Engineering Coordinator's Preception of the DOD Value Engineering Program. GRA

SPACE SCIENCES

Includes space sciences (general), astronomy, astrophysics, lunar and planetary exploration, solar physics, and space radiation

N85-34766*# Aerospace Corp., El Segundo, Calif Space Sciences Lab

A SEARCH FOR SOLAR NEUTRONS ON A LONG DURATION BALLOON FLIGHT

R KOGA, G M FRYE, JR (Case Western Reserve Univ), A OWENS (Case Western Reserve Univ), B V DENEHY (Melbourne Univ, Parkville, Australia), O MACE (Melbourne Univ Parkville, Australia), and J THOMAS (Melbourne Univ, Parkville, Australia) /in NASA. Goddard Space Flight Center 19th Intern Cosmic Ray Conf, Vol 4 p 142-145 Aug 1985 refs Sponsored in part by the Royal Australian AF, and by Australian Research Grants Committee

(Contract NSF ATM-82-06044)

(SH-1 4-6) Avail NTIS HC as boxed set only \$200/MF A01 per volume or E99 per entire set CSCL 03B

The EOSCOR 3 detector, designed to measure the flux of solar neutrons, was flown on a long duration RACON balloon flight from Australia during Jan through Feb, 1983 The Circum-global flight lasted 22 days No major solar activity occurred during the flight and thus only an upper limit to the solar flare neutrons flux is given The atmospheric neutron response is compared with that obtained on earlier flights from Palestine, Texas

Author

N85-35966*# Bordeaux 1 Univ, Gradignan (France) Lab de Physique Theorique

ULTRA HIGH ENERGY EVENTS IN ECHOS SERIES AND PRIMARY ENERGY SPECTRUM

J N CAPDEVIELLE, J IWAI (Tokyo Univ), and T OGATA (Tokyo Univ) /in NASA Goddard Space Flight Center 19th Intern Cosmic Ray Conf, Vol 6 p 447-450 Aug 1985 refs

(HE-3 7-9) Avail NTIS HC as boxed set only \$200/MF A01 per volume or E99 per entire set CSCL 03B

The compilation of ultra high energy jets suggests at present the existence of a bump in primary energy spectrum (with the standard concept of high energy collisions) The pseudo-rapidity distribution exhibits some typical anomalies, more than the (P sub t) behavior, which are (may be) the fingerprints of quark gluon plasma transition The next results of Emulsion Chamber on Supersonic (ECHOS) will be in both cases determinant to confirm those tendencies, as well as an important effort of the cosmic ray community to develop in that sense a flying emulsion chamber experiment

Author

advice, technological support, and assistance to other NASA installations, other government agencies, and industry Some of the significant tests which were performed during calendar year 1984 in Langley test facilities are highlighted The broad range of the research and technology activities at the Langley Research Center and the contributions of this work toward maintaining United States leadership in aeronautics and space research are illustrated

R J F

GENERAL

N85-35151*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va

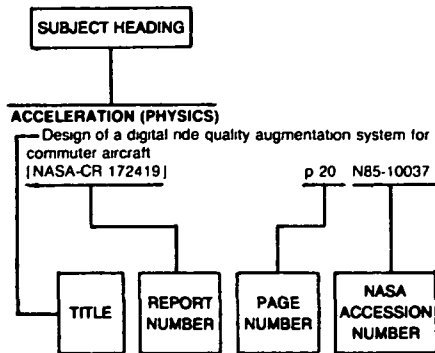
LANGLEY AERONAUTICS AND SPACE TEST HIGHLIGHTS, 1984

1984 89 p refs

(NASA-TM-87585, NAS 1 15 87585) Avail NTIS HC A05/MF A01 CSCL 05D

The role of the Langley Research Center is to perform basic and applied research necessary for the advancement of aeronautics and space flight, to generate new and advanced concepts for the accomplishment of related national goals, and to provide research

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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Energy efficient engine, high pressure turbine thermal barrier coating Support technology report [NASA-CR-168037] p 892 N85-35199

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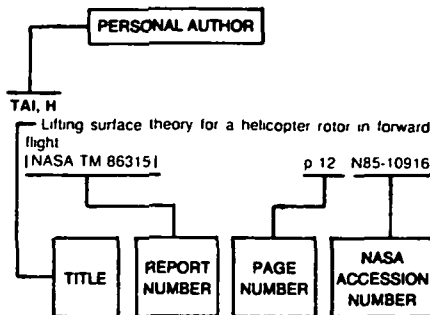
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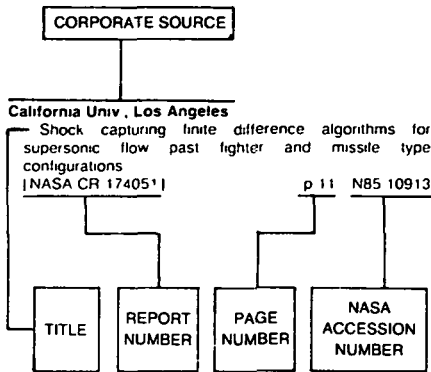
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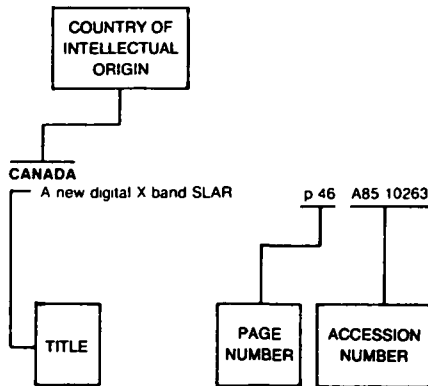
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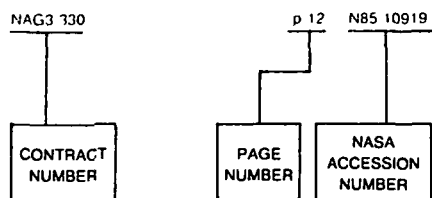
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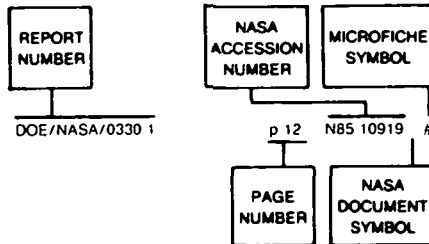
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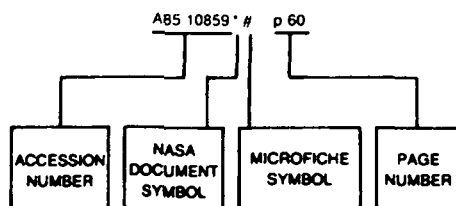
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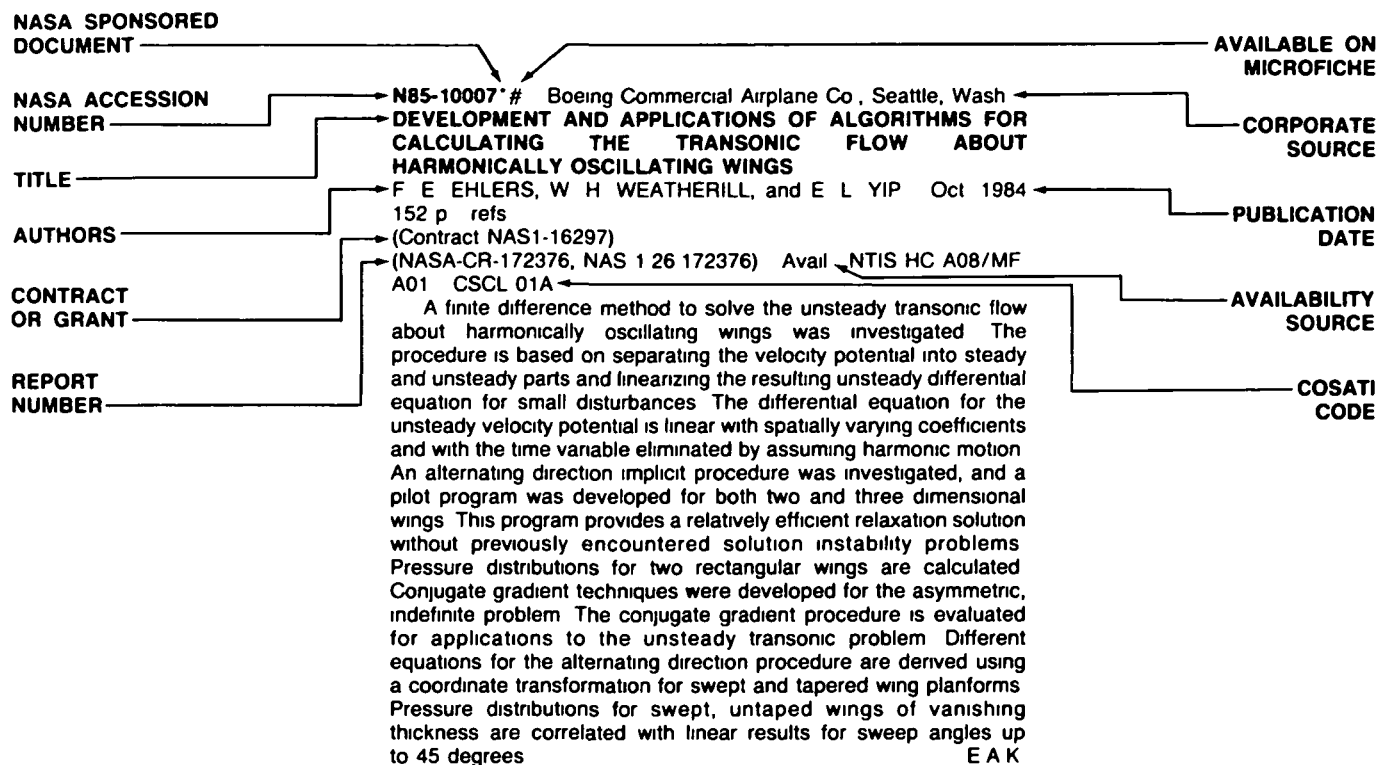
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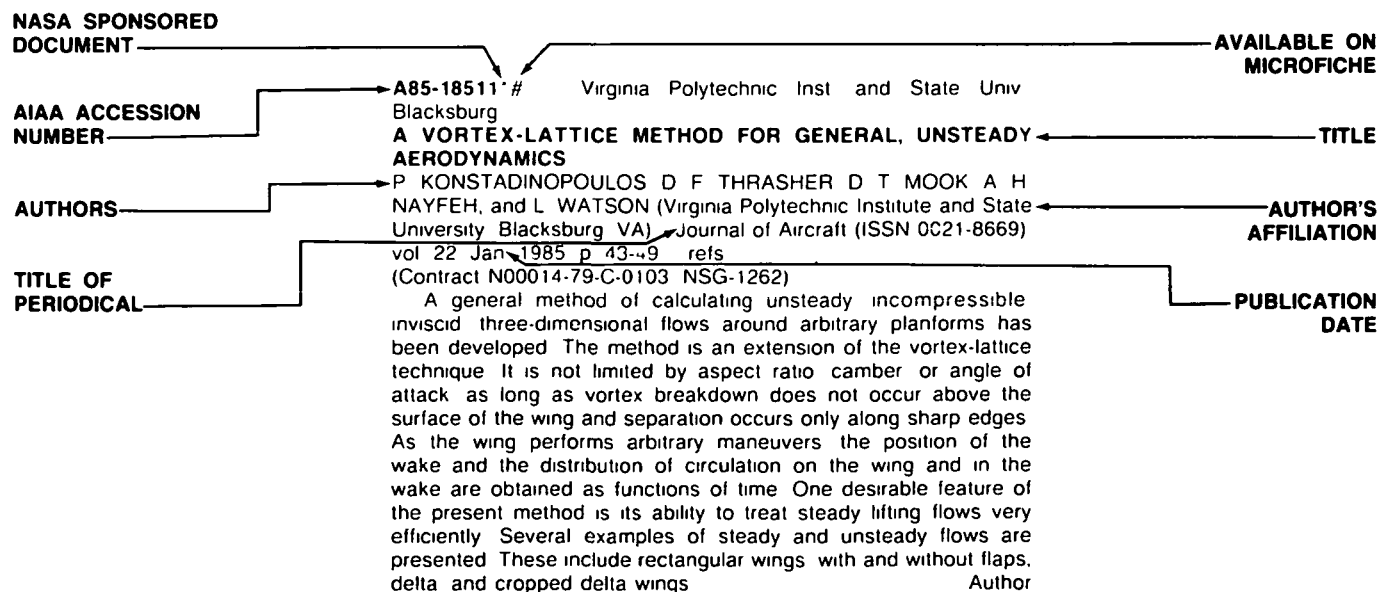
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